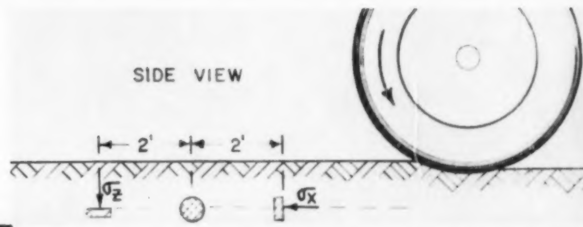
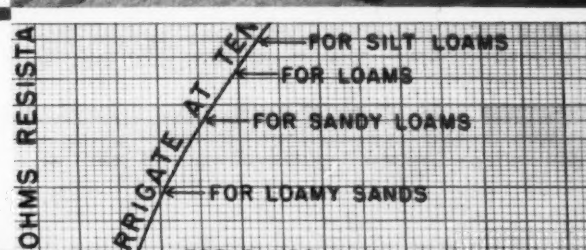
JANUARY 1960

Agricultural Engineering

The Journal of the American Society of Agricultural Engineers





Agricultural Engineering

Established 1920

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JAMES BASSELMAN, *Editor and Publisher*

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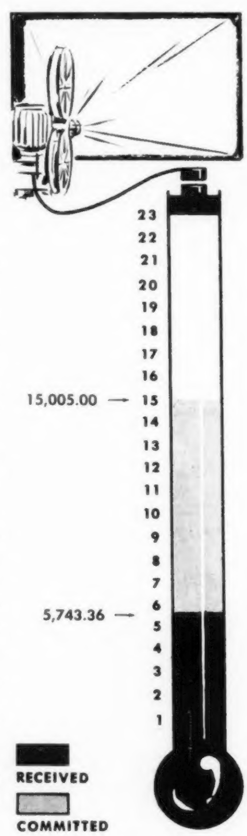
Cabinet Hears Motion Picture Report

THE major portion of the Cabinet meeting held during the Winter Meeting of ASAE, Tuesday, December 15, at the Palmer House Hotel in Chicago, was devoted to the ASAE motion picture project. Film shooting progress was reported by H. S. Pringle, member of the Production Committee. He stated that some footage has already been taken and the remainder is to be completed before May 1. The original complete copy is scheduled for June 1 and some copies will be available by June 15 for distribution to colleges who placed advance orders. R. G. Morgan, chairman of contributions from Sections, reported that all 29 ASAE Sections have accepted all or part of their assigned quotas and that 25 have paid all or part. Final December 31 records indicated that 22 Sections have completed payment, 10 of which oversubscribed their quotas. J. W. Borden, vice-president of ASAE and chairman of the Finance Committee, gave an optimistic report on the progress of contributions from colleges and special individuals. He stated that industry had not been contacted for contributions as yet. He seemed confident that industry would more than meet its assigned quota since ASAE members have shown such wonderful support. Contributions from college agricultural engineering departments have already exceeded the assigned quota by $1750.00. To date 27 copies of the film have been ordered by colleges. L. W. Hurlbut, president-elect of ASAE and chairman of the Motion Picture Production Committee, encouraged Cabinet members to take advantage of every opportunity to make use of the motion picture after it is available and to organize distribution plans for obtaining maximum benefits.



During the month of December, cash received for the motion picture fund increased to $5,743.36. Additional commitments made during the month brought the total to $15,005.00, leaving a total of $7,995.00 yet to be raised to meet the goal of $23,000.00.

Mid-Central, North Carolina, Michigan, and South Carolina Sections completed their quotas during the month, bringing the total of paid up Sections to 22. The Hawaii Section made an additional contribution during the month and has now contributed three times its original pledge.

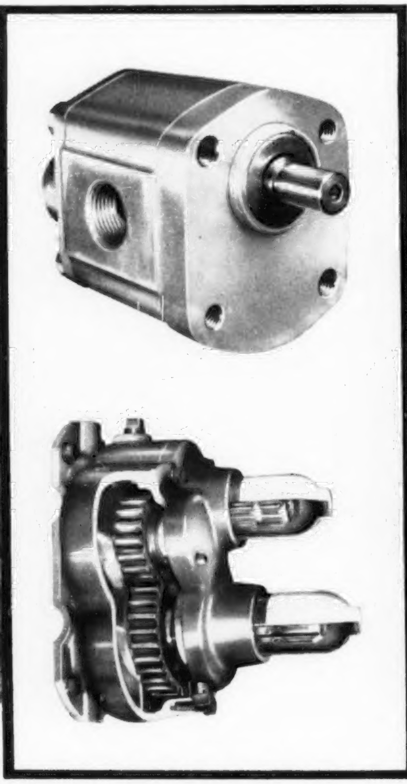
The following Sections have paid or surpassed their assigned quotas: Washington, D.C.; Southwest (including Oklahoma and Baton Rouge); Mid-Central; Quad City; Pacific Coast; Pacific Northwest; Connecticut Valley; Florida; Georgia; Hawaii; Iowa; Kentucky; Michigan; Minnesota; North Carolina; Pennsylvania; South Carolina; Tennessee; Virginia; and West Virginia.

Watch this column each month to observe the progress of the motion picture project.

TWO MAJOR SOURCES OF...

POWER TRANSMISSION

BACK OF BOTH... B-W



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A new B-W dual range power take-off adapter by Warner Automotive Division engineers can be fitted to any tractor, operates farm implements at *either* 540 or 1000 rpm. Saves time and labor . . . up-dates older tractors and up-grades new tractors. Engineered to virtually any rpm requirements for industrial applications. Use Warner engineers—your major source of power transmission gears, gear assemblies, ring gears and pinions, differential parts and assemblies, and spline shafts.

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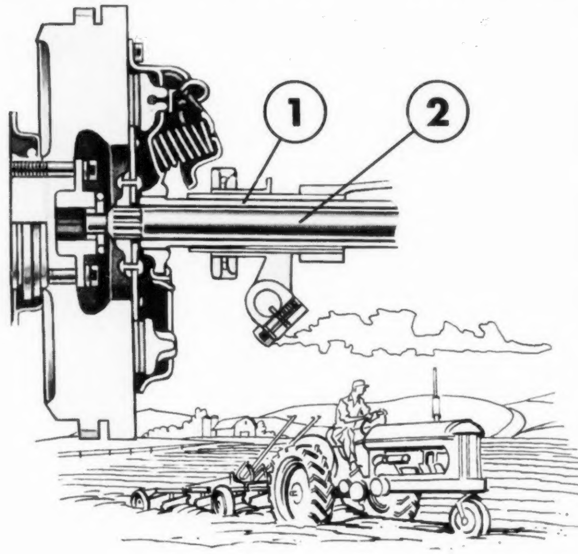
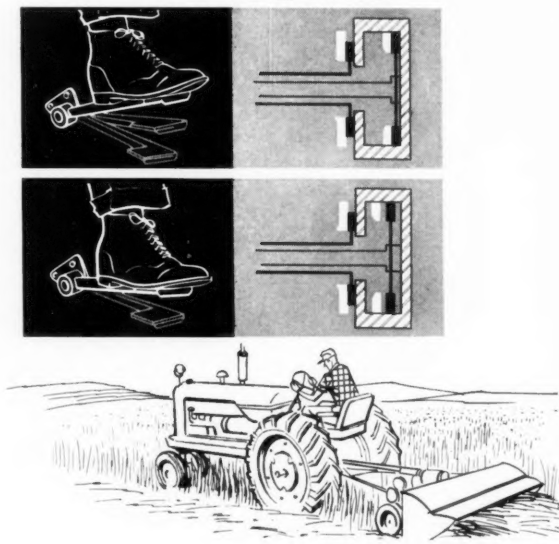


Split-Torque Type Clutches

Dual Drive Type Clutches



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Split-Torque Type Clutches which deliver torque flow from one power source to do two *different* jobs. Available in sizes from 8½"-12", with nominal torque capacities ranging from 165 to 390 lbs. ft.

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Dual Drive Type Clutches supply selective drive to both tractor and implements with single pedal control. 9"/11" size has a nominal torque capacity of 152-202 lbs. ft. The 10"/12" size has a capacity of 261-306 lbs. ft.

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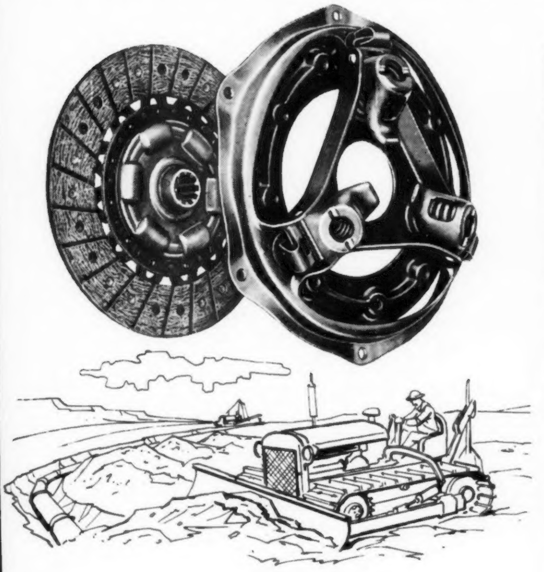
Since the axle tubes are pressed into the center section, Spicer axles can be adapted to a great many variations in mounting arrangements as well as tread and wheel end design, by changing only the axle shafts and tubes. The center section is not affected. The economic advantages of this flexibility are evident in low piece prices and minimum tooling costs.

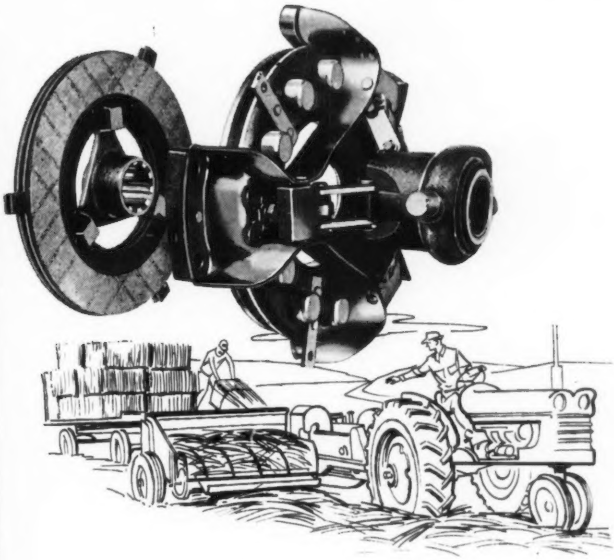
Spicer Telescoping Square Propeller Shafts are available for use with all types of agricultural PTO applications for continuous or intermittent service. No welding or realignment necessary.

Write now for information on the complete line of Spicer clutch and drive train components.

POWER TRANSMISSION PROBLEMS!



Spring Loaded Type Clutches



Constant Pressure Type Clutches

Spicer Axles

Tree Knocker developed by P. A. Radocy & Sons

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Report to Readers . . .

WHY BRUISED FORAGE MAKES BETTER SILAGE USDA scientists have come up with an idea for making better silage that will be of special interest to designers and manufacturers of ensilage machinery. Their experiments show that almost 10 percent more dry matter can be recovered in silage made from finely chopped and bruised forage than from coarsely cut forage. They also found that bruised-forage silage was more acidic than chopped-forage silage, and that it contained larger quantities of the desirable lactic acid. In addition, the bruised silage contains less butyric acid and ammoniacal nitrogen, both undesirable in silage. . . . . The scientists believe that the better quality silage produced by bruising is due to rupture of a high percentage of plant cells, which caused fermentation to be more rapid and of a much different nature than that occurring in coarsely chopped forage.

FARM PRODUCTION AND THE LONG LOOK AHEAD Since census projections indicate a possible US population of 230 million by 1975, USDA economists say farmers will have to produce an average of 35 to 45 percent more than at present to feed the nation 15 years hence. The economists say further that, while such a production goal could be attained by bringing more land into production, it would probably be more economic to produce the gains through wider application of present technology and further research results. To do this, they say, it will be necessary to devise improvements 30 percent faster than was done during the two fruitful decades prior to 1956. . . . . Even more formidable is the job beyond 1975. In the light of the present outlook, the USDA estimates that improvements in farm practices will be required at a rate 160 percent as great as in the last two decades. This will emphasize the need for greatly strengthening research programs to provide the new technological information that will be needed by farmers and related industry. . . . . The tremendous challenge which this broadening outlook implies will be self-evident to the readers of this journal.

HARVESTING OF BLUEBERRIES SOON TO BECOME MECHANIZED A faster, lower cost, bigger harvest of blueberries is about to result from the collaboration of ARS (USDA) and Michigan AES agricultural engineers in devising the mechanized equipment needed for this purpose. Devices under test this past season enable a picker to harvest three times as many berries per hour as he can pick by hand. These devices include an electric vibrator to shake berries from the bushes, a two-bush berry collector, and a pneumatic sorter. In tests made by the researchers, these aids enabled a picker to pick 28 pounds of berries an hour, as compared with the hourly average of 9 pounds for picking by hand. Mechanical harvesting costs were 3½ cents per pound; handpicking costs averaged 8 cents. . . . . The studies showed that two workers, each using a vibrator and a two-bush collector, could harvest 12,500 pounds of berries in 30 days. A pneumatic sorter, that can be operated by one worker, has a capacity of at least 500 pounds per hour.

NEW TYPE OF GRAIN DRIER WORKS ON CASCADE OR CONVEYOR SYSTEM What is said to be completely different from any other grain drier on the market is one developed in England that has a slatted bed and works either on the cascade or conveyor principle. It is claimed to handle anything from clover seed to beans. . . . . The drier is composed of inclined, overlapping louvers, and there are no perforated sheets to clog or to allow dust to enter the heating chamber. A continuous draft of air through the louvers removes all dust and leaves the tray clean at the end of the drying operation. . . . . The depth of the grain is controlled by roller dams. As the moving grain turns, it also turns the rollers, which insures even drying. The cascade model of this drier is said to have a drying capacity of 800 to 1,000 pounds per hour, while the conveyor-type model will dry up to 12 tons per hour. *(Continued on page 12)*

JOHN DEERE "30

offer forward-looking farmers

It's a big day on any farm when a new John Deere "30" Series Tractor is delivered. To the profit-minded, forward-looking farmer, delivery day represents the arrival of a better tomorrow.

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EXPERIMENTAL VERTICAL SILAGE ELEVATOR SHOWS MUCH PROMISE

Illinois AES agricultural engineers have designed and tested a vertical elevator that may well be one answer to the need for more efficient and versatile means of filling vertical silos. Two continuous chains, to which forked flights are attached at 10-inch intervals, are used in this elevator. At the lower or intake end, these flights move upward at a 45-degree angle from the horizontal. The silage falls between successive flights thereby minimizing wedging and throwout problems. . . . . At the upper end of the elevator, the silage is thrown clear of the flights by centrifugal force as they turn on the upper sprockets. The silage then falls freely down the distributor pipe into the silo. . . . . Silage is fed into the elevator by either a separate hopper or a side-delivery, self-unloading wagon. A 5-hp, single-phase, repulsion-induction motor was used to drive the elevator. . . . . In performance tests, in which both grass and legume silage were used, field-chopped alfalfa was elevated to 40 feet at rates up to 23 tons per hour without completely loading the motor.

ELECTRIC CURING REMOVES RISK IN PROCESSING OF AROMATIC TOBACCO

Natural curing of aromatic tobacco in the US is risky on account of variable weather in production areas. To eliminate this risk, ARS (USDA) and Virginia AES agricultural engineers are showing growers how they can provide the proper environment indoors by insulating curing barns and equipping them with automatically controlled electric heaters and circulating fans. This system of curing costs about 10 percent of the crop's value, which is relatively inexpensive, since aromatic tobacco brings about 80 cents a pound.

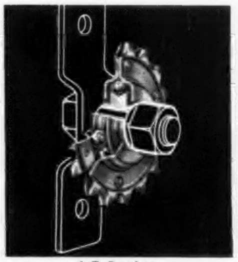
KEEPING MARKET HOGS COOL RESULTS IN FASTER GAINS

In cooperative tests conducted by California AES and ARS (USDA) agricultural engineers on the relation of creature comfort to gains made by hogs being prepared for market, results stress the simple fact that cool hogs gain faster. Under favorable conditions in a psychrometric chamber, test hogs consistently gained 2 pounds a day, but in the case of those living outside under naturally varying conditions the daily gains did not exceed 1½ pounds. . . . . The engineers, in accounting for the difference in gains, are convinced that some kind of cooling is essential for hogs in hot weather, since daily weight gains begin to drop fast when temperatures reach 75 to 80 F. . . . . Some useful information has been revealed on the comparative value of several outside cooling systems. Ordinary wallows in the sun were found just as effective in increasing the rate of gain as some other more elaborate and expensive means. There were no significant weight differences in hogs cooled by the various methods used.

A NEW TYPE OF POTATO DRIER QUICKLY REMOVES WASH WATER

With atmospheric conditions such that potatoes remain wet or damp after washing and packaging, they are subject to losses from bacterial soft rot. For complete removal of wash water prior to packaging, artificial drying is necessary. . . . . For this purpose, California AES agricultural engineers have developed an experimental drier that, in the laboratory, has completely removed residual wash water in 2 to 5 minutes without damage to the potatoes. This drier has several new design features. Potatoes are moved through it in a mass rather than in a single layer, which makes it possible to move a large volume at a slow conveyor speed. Because of this the unit can be relatively short and still hold the potatoes in it long enough for proper drying. The drying air passes through the mass of potatoes twice, thereby giving a relatively high thermal efficiency. Also, the warmest and driest air comes in contact with the wettest potatoes, which tends to decrease the possibility of damage from overheating or overdrying. . . . . The researchers estimate the maximum capacity of the experimental unit at about 300 sacks per hour. They also believe the drying time could be reduced and capacity increased by using heated air at temperatures as high as 150 F.

Cylindrical Roller Bearings



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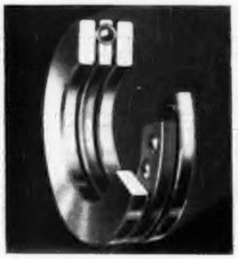
AG Series Belt Idlers

AG Series Adapter Bearings



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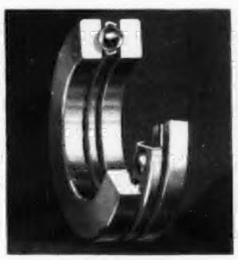

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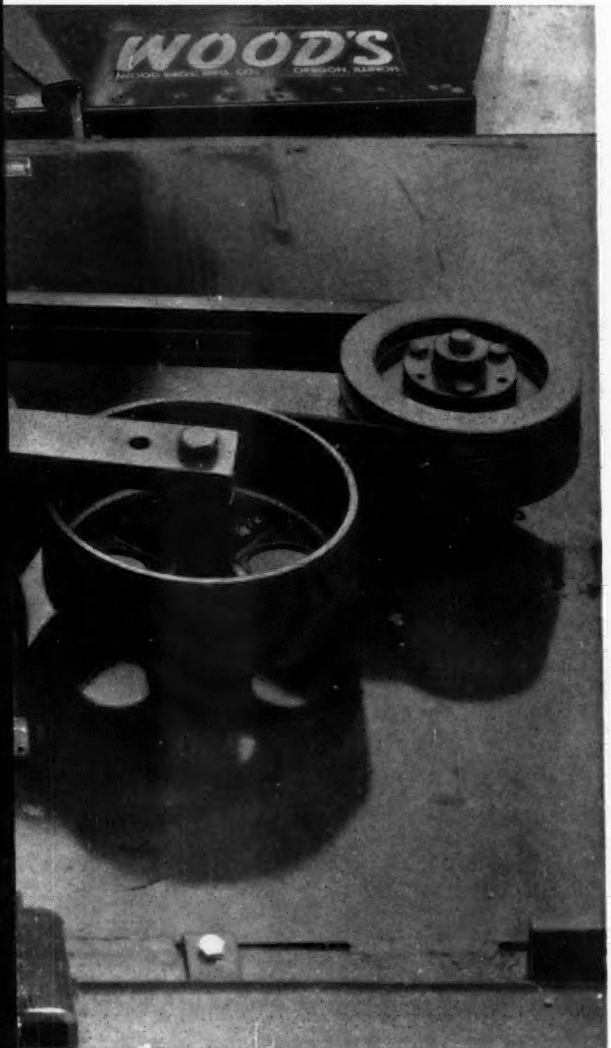

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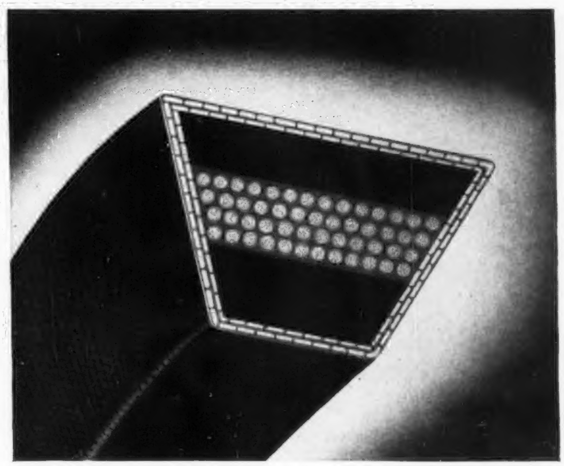

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Agricultural Engineering

January 1960
Number 1
Volume 41

James Basselman, Editor

OPPORTUNITY IN 1960

AGRICULTURAL engineering opportunities of the future are indicated in some measure by current listings of openings.

As shown by ASAE Personnel Service listings carrying over from 1959, the major call in the farm equipment industry is for design and development men. The evident shortage, and recognition of the importance of continued design engineering to manufacturers of mechanical equipment for agriculture, is notably widespread rather than concentrated.

In the other division fields, two organizations are looking for sales engineers in larger numbers than usual. Their jobs too will be partly a matter of design. These employers are looking to agricultural engineering for men competent to design components into practical, profitable, and salable farm operating installations.

These opportunities came into being largely as a result of the proven success of some agricultural engineers in similar positions. Each successful agricultural engineer, by his record, adds to the demand and opportunity for others.

To hold up their end of the demand for progress in agricultural engineering, the college agricultural engineering departments and other public agencies are continuing to look for as good and as many agricultural engineers as their budgets will afford. Notably there are opportunities in graduate study for able young engineers to broaden their foundations in preparation for the climb to higher levels of professional capacity, service, and achievement.

We are not saying that all young agricultural engineers should try to follow the same path to professional progress. As a major branch of the engineering profession, agricultural engineering is necessarily a composite of men with a wide variety of abilities, matched to a wide variety of opportunities.

We are saying that, for those with appropriate aptitudes, the long road of continuing preparation for productive original work, in design or other creative capacities, can be especially rewarding. The opportunity is here, now.

The specific indications on which we base this conclusion are those of the ASAE Personnel Service, for 1959.

During the year it carried 85 new position open listings for 147 or more openings. At the end of the year 43 were still current. Others had been cancelled automatically after being carried for 6 months, or earlier on request from the employers concerned, due to the openings being filled or cancelled.

In the 43 remaining active, 33 employers with openings for 94 or more individuals were represented. We say "or more" since we counted only three openings for each of three listings showing "several" openings, and the lower figure for each of two other listings which indicated a range in the number of openings to be filled.

Private enterprise was represented by 23 employers with 32 listings of 77 or more individual openings. Of these the power and machinery field was represented by 18 employers with 26 listings covering 42 openings. Thirty-six of these openings were for design and development engineers, ranging from beginners to heads of design and development departments. The other six openings were in research and testing, sales, and service.

Among public service agencies, 10 employers had 11 listings covering 17 or more openings, in which the technical divisions were quite uniformly represented. Ten of the openings were in research, two in teaching and research, three in teaching, and two in extension. Seven of the 10 research opportunities were for graduate assistants.

In comparison there were 25 current published listings of men looking for new positions. Of these, four will not be available for another 6 months or more. Among the others few appeared closely matched to any of the current openings, in their particular combinations of qualifications and preferences.

For obvious reasons many employers prefer not to use published listings for some of the top openings which become available. Still, it is important that these key positions be filled by agricultural engineers who fully meet the requirements and can ably represent the profession. Generally they can be filled, sooner or later, by men already holding other positions only slightly less important. However, it is our observation that the time required to find top agricultural engineers who are qualified and available for consideration, is often excessive. In some cases this has resulted in the position being abandoned, or filled by someone other than an active leader in agricultural engineering. This represents lost opportunity.

Since the Society's Personnel Service is only a supplement to other means by which employers and individual agricultural engineers make contacts, the openings shown are *only a fraction of the total new employment opportunities* in agricultural engineering.

The major demands shown represent existing opportunities in recognized work for agricultural engineers, to be fulfilled before many agricultural engineers can become available to explore and develop their potential usefulness and opportunities in a broader range of service to agriculture.

Opportunity for engineering to render valuable service to agriculture, and to many of its related industries, is now more widely recognized than ever. To make the most of this opportunity, *agricultural engineering needs more trained manpower.*

Editor's Note: This editorial was prepared by R. A. Palmer, assistant-secretary and treasurer of ASAE, who is in charge of the ASAE Personnel Service.

Stress Distribution in Soils Under Tractor Loads

C. A. Reaves and **A. W. Cooper**
Member ASAE Member ASAE

Results of comparative stress-distribution measurements under pneumatic tires and track-type tracks

THERE has been considerable difference of opinion on the relative compaction of agricultural soils by traffic of tractor tracks and tires. Points of discussion include magnitude of soil contact pressures, effects of area and shape of contact surfaces on depth of stresses, effects of vibration transmitted from tractor engine to soil, effects of impact loads due to lugs and cleats striking the soil, and effects of impact loads due to changes in track velocity and changes in tractor elevation as the drive-sprocket teeth engage the track chain. Limited data are available on some of these points. Gliemeroth (1)* photographed the path of some soil-particle movements under pneumatic tires and track-type tracks, Reed (2) measured forces applied to soil by a track with one shoe instrumented, Vanden Berg and Gill (3) studied pressure distributions applied to soil by a smooth rubber tire, Soehne (4) studied pressure distribution and soil deformation under tractor tires, the Waterways Experiment Station, Corps of Engineers (5) measured pressures in soil at depths down to 8 in. under vehicle tires, Culpin (6) reports pressure in soil under a ribbed roller, and Bekker (7) discussed soil parameters as they affect traction.

The ultimate objective in designing tractive devices for agricultural equipment is to provide the required tractive effort with minimum detrimental effects on soil structure. A step toward determining the factors necessary for this design is the measurement of the stress distribution in soil under various shapes of loads. Strain measurements are also needed but a satisfactory method for determining strain has not been developed. Bulk-density samples are perhaps the best method for determining final soil strain but they leave much to be desired because sample precision is not within the minimum tolerance needed for stress-strain studies. Within normal soil conditions encountered in agriculture, bulk-density change is very insensitive to changes in stress. An objection to bulk-density samples is that initial and final samples are not a sample of the same volume and reversals often occur due to ununiform soil conditions.

This paper reports results of the comparative stress-distribution measurements in Congaree silt loam soil under a 12-in. tractor track and a 13-38 tractor tire carrying the same total dynamic load and pulling the same drawbar load. Bulk-density measurements were made but the results were erratic and are not reported.

Paper presented at the Annual Meeting of the American Society of Agricultural Engineers at Ithaca, N. Y., June 1959, on a program arranged jointly by the Power and Machinery and the Soil and Water Divisions.

The authors — C. A. REAVES and A. W. COOPER — are, respectively, agricultural engineer and director, National Tillage Machinery Laboratory (AERD, ARS), USDA.

*Numbers in parentheses refer to the appended references.

Apparatus

The tire-testing unit as described by Reed and Berry (8) was used to motivate both the track and the tire. Dynamic load and drawbar pull were maintained at 3600 and 1500 lb, respectively, while stress measurements were made under both the tire and track. The inflation pressure of the tire was 16 psi. The load of 3600 lb was the maximum recommended for the tire at this inflation pressure. This is also approximately the load carried by each track of a D-2 Caterpillar tractor. Torque, drawbar pull, load transfer, and percent slip were recorded continuously for the tire. Torque, drawbar pull, percent slip, and horizontal and vertical forces on one track shoe were recorded continuously for the track. Strain-gage pressure cells (9) were employed to measure stresses within the soil. Congaree silt loam soil was used, in a bin 20 ft wide, 250 ft long, with a soil depth of 5 ft. Bulk density and moisture measurements were obtained with the modified Lutz technique.

Procedure

The soil was rotary tilled 20 in. deep, rolled approximately 6 in. deep on 1¼-in. centers with subsurface press wheels, and the surface was flat rolled. Water was added as needed to maintain moisture content as closely as practical. Trenches were opened by hand for positioning strain-gage pressure cells. The centers of the sensitive diaphragm of the cells were placed two feet apart at each depth, in a horizontal line perpendicular to the tractor axle. Three stress measurements were made at each depth, one parallel to a vertical plane through the tractor axle, one parallel to a plane through the tire periphery, and one parallel to the soil surface (Fig. 1). Pressure measurements were made on 3-in. increments from the center line of tire and track laterally 12 in. and downward to 42 in. or until the reading was less

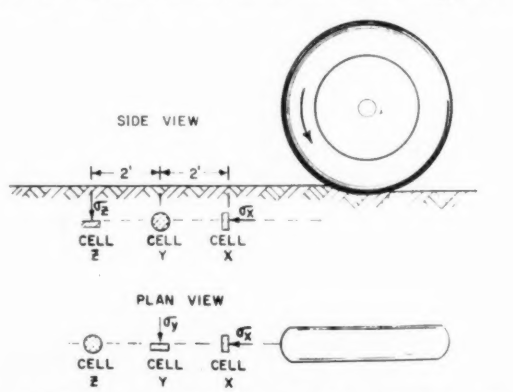

Fig. 1 Cells were oriented in three mutually perpendicular planes to measure stresses σx, σy, and σz, under the tire and track

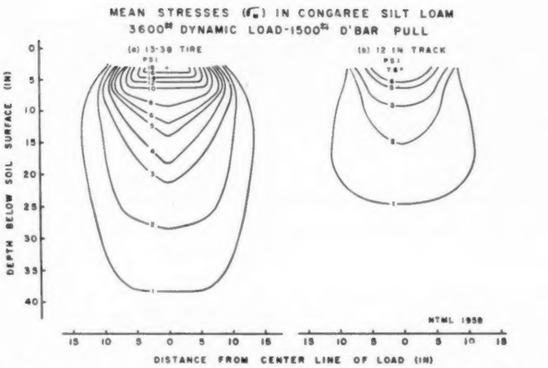

Fig. 2 Isograms of mean stresses (σm) perpendicular to the direction of travel in Congaree silt loam

than 2 psi. After the cells were placed, the trench was refilled and tamped. Bulk density and moisture samples were taken before and after tests at positions equivalent to those where stress measurements were made.

Results

Isograms drawn from stress measurements are given in Figs. 2, 3 and 4. Fig. 2 shows isograms of mean stresses $(\sigma_x + \sigma_y + \sigma_z)/3$ under the 12-in. track and 13-38 tire. These data show that stresses were at least twice as great under the tire as under the track. Fig. 3 shows isograms of

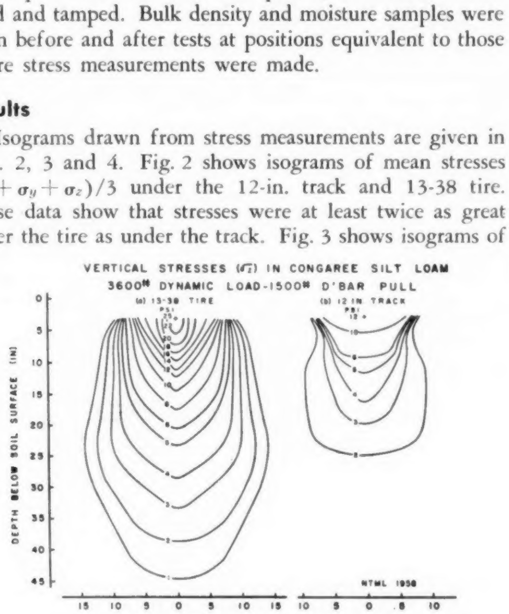

Fig. 3 Isograms of vertical stresses (σz) perpendicular to the direction of travel in Congaree silt loam

stresses in the z or vertical direction, perpendicular to direction of travel. Due to large displacement of the surface soil under the tire and track, movement of pressure cells was so great that data were not obtained at the surface. Maximum stresses occurred under the center of both tire and track at the 3-in. depth and in general stresses decreased from this point both laterally and vertically. Stresses under the tire were in almost every case at least twice as great as under the track for any position. A stress of 12.3 psi occurred under the track center at a depth of 3 in. to compare with 25.4 psi for the 13-38 tire. Fig. 4 shows isograms of stresses in the z direction parallel to direction of travel. Data obtained under the centerline of the track only are shown. It is noted that the isograms are skewed less than would normally be expected. As in Fig. 3, the data show higher intensity of stresses under the tire. This is feasible because contact length for the tire is approximately 2 ft while that for

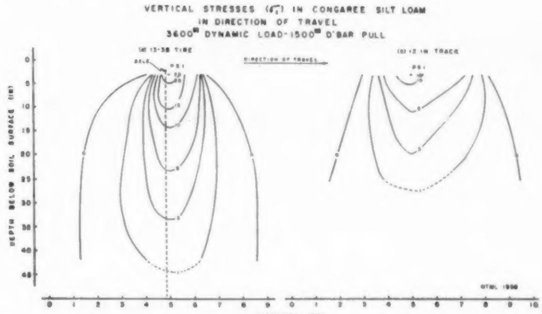

Fig. 4 Isograms of vertical stresses (σz) parallel to the direction of travel under the centerline of the track and tire in Congaree silt loam

the track is 5 ft and they carried the same dynamic and drawbar load.

Lower plastic limit and lower liquid limit for the Congaree silt loam are 33.7 and 55.0 percent. The moisture content during the tests was below the lower plastic limit, except for the greater depths. The lower plastic limit is the maximum moisture level at which any tillage operations should be performed.

Cooper and Reaves (10) presented comparative stress curves at a depth of 9 in. in Hiwassee sandy loam under a 13-38 tire and a 12-in. track. Results were a smooth curve of higher magnitude and shorter duration for the 13-38 tire, while the curve for the track showed a vibrating stress which was correlated with stresses applied to the surface of the soil due to the action of the drive sprocket. Fig. 5 gives typical stresses measured under the centerline of 12-in. track

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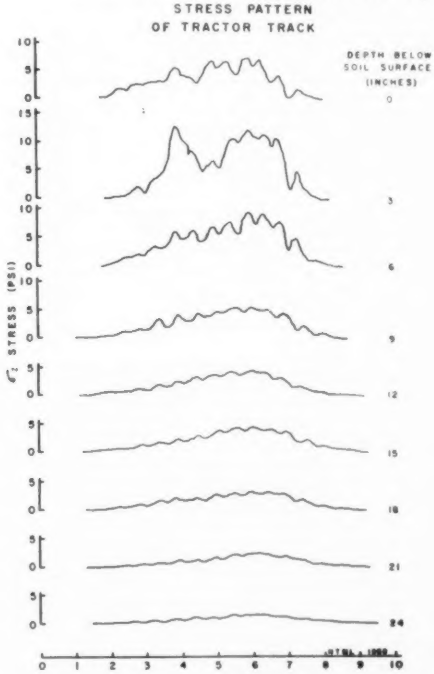

Fig. 5 Stress applied to the surface of Congaree silt loam and the stress pattern at various depths in the soil below the track. The top curve was made with track shoe dynamometer. All others were made with pressure cells and recording oscillograph

Factors Affecting Hydraulic Removal of Manure from Concrete

J. B. McQuitty, J. S. Boyd and C. M. Hansen
Member ASAE Member ASAE

Report of a research study on cleaning the concrete surfaces of livestock areas

CONSIDERABLE interest has been shown recently in the liquid system of handling manure. Water is used to wash the concrete livestock area into drains or into holding tanks for disposal on crop land. Jedele (1)* reports a trend to such a system in the midwestern states. This system of handling manure is not new but had fallen into disfavor due largely to lack of adequate handling equipment (2).

Anderson (3) estimates that existing manure-handling systems utilize only one-third to one-half of the potential crop-producing and soil-conserving value of manure produced annually in the USA. Since urine is also conserved, the liquid-manure system may offer a more efficient method of conserving the potential value of the animal excreta. Turner et al (4) stresses the importance of dilution in that too much water may make distribution of liquid manure uneconomical. Preliminary work at the University of Illinois indicates that distribution is an economic problem.

Automation in cleaning the livestock area would be quite desirable. Puckett et al (5) have demonstrated this to be practical in a confinement hog installation. In large feed lots, however, dilution may be excessive and it is suggested (2) that it may be more practical to first scrape the solids into gutters before flushing them into a holding tank.

The very limited data available emphasizes the need for controlled investigations of factors affecting the hydraulic removal of manure from concrete. This investigation was conducted to determine the effect of nozzle type, pressure and design of floor surface roughness as it affects the removal of manure.

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The authors — J. B. McQUITTY, J. S. BOYD, and C. M. HANSEN — are, respectively, county agricultural advisory officer, ministry of agriculture, Ireland, and professor and assistant professor, respectively, of agricultural engineering, Michigan State University.

Acknowledgment: The authors express appreciation to the John Bean Division, Food Machinery and Chemical Corp., for the loan of the piston-type pump used in the study reported in this paper.

*Numbers in parentheses refer to appended references.

Experimental Apparatus

A piston-type pump with a capacity of 10 gpm at 400 psi was used to pump the water. A "trolley" was propelled along a track by a ½-hp electric motor acting through a variable-speed, reversible, hydraulic transmission. A nozzle was clamped to the trolley, making the stream of water perpendicular to the direction of travel, and was directed on the concrete slabs set parallel to the track. The slabs, each 2 by 1 ft and 2 in. thick, represented three replications of three degrees of surface roughness — smooth, medium, and rough — obtained by a steel trowel, a wood float and a brush, respectively. The slabs were given a slope of ¼ in. in 1 ft (Fig. 1).

Procedure

Preliminary investigations were necessary to assist in arbitrary selection of the numerous variable factors involved. These preliminary tests indicated that the distance of the nozzle from the surface, the angle from the horizontal at which the stream of water hits the surface, the speed of the trolley and the distribution of the manure on the surface affected cleaning effectiveness.

The distance of nozzle to surface was fixed at 30 in., the angle of the water stream to the surface at 20 deg and the speed of the trolley at 30 fpm. The problem of manure distribution was overcome by using a mold with a uniform position maintained on each slab. Hog manure with a dry matter content of 30 percent, collected from a feedlot, was thoroughly mixed to give a standard material. These values were kept constant.

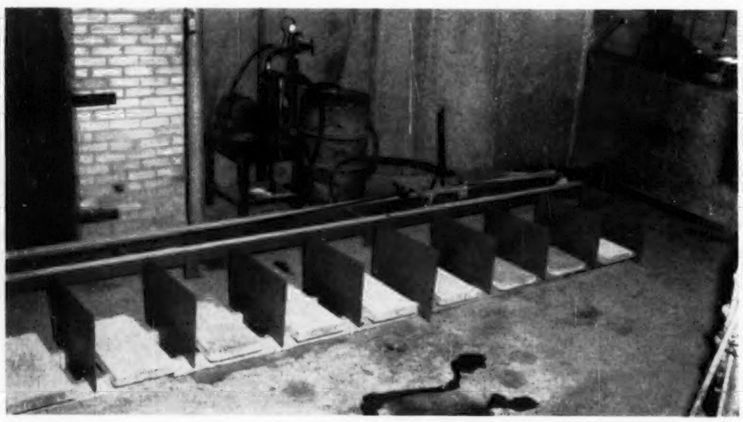

Fig. 1 View showing the piston-type pump and general arrangement of apparatus used in the experiment reported in the accompanying paper

Preliminary work with an adjustable nozzle to give different conical spray patterns, indicated that it became less effective as the spray angle was increased. The large number of nozzles available was narrowed down to three types. Nozzles with conical-spray patterns were less effective than those with either solid-spray or flat-spray patterns. Four nozzles were subsequently tested with 0, 15, 25 and 40 deg spray angles at 40 psi. Delivery rate for the four nozzles was the same for any given pressure. Table 1 shows the relationship between pressure and nozzle capacity.

TABLE 1. RELATIONSHIP BETWEEN PRESSURE AND CAPACITY FOR THE NOZZLE UNDER TEST

Pressure (psi)	Capacity (gpm)
40	4.0
60	4.9
80	5.7
100	6.3
120	6.9

Difficulty was experienced in selecting a suitable criterion for evaluating efficiency of removal. Weight difference of material removed was unsatisfactory as the manure absorbed water. In some instances, the residual weight was greater than the initial weight of manure placed on the slab. Washing the residue from the slab and filtering off excess liquid was impractical as the colloidal content of the manure rapidly plugged the filter.

The use of an inert material to replace the manure was, therefore, desirable. Air-dry sand which passed through a 30-mesh screen and was caught on a 60-mesh screen was used. A mold of 50 grams of sand was placed on the dry surface of each slab in a uniform position. The slabs were flushed with one pass of the nozzle and the residue from each rinsed into a collecting basin. The washings were then filtered for a period of 3 min and weighed. The accuracy of this technique was tested and results were within a range of 1 percent.

The procedure was repeated for each of the four nozzles with a pressure of 40 to 120 psi at 20-psi intervals.

The correlation of the results with sand and manure was investigated using one set of conditions varying only pressure. On each slab, 1,000 grams of manure were placed in a uniform position, using the mold. The slabs were flushed once using the solid spray nozzle. The residues were dried on the slabs by a battery of infrared heat lamps, for a period of 18 hr. They were then weighed after careful removal from the slab. The manure (and the sand) was always placed on the dry slab surfaces to simulate what is most likely to occur in practice.

Results

With sand, the solid spray nozzle was superior to the other three using a flat type pattern (Fig. 2). This was also true when manure replaced the sand. The superiority was highly significant at all pressures. Very careful observation confirmed this result also with manure.

Increasing pressures from 40 to 60 psi and 60 to 80 psi resulted in highly significant improvements in cleaning effectiveness when the solid spray nozzle was used on sand. Improvements were significant, but at the 5 percent level when pressures were increased from 80 to 100 psi and from 100 to 120 psi. When manure replaced sand and the same solid nozzle was used, increasing pressure from 40 to 60 psi resulted in no improvement. When the pressure was increased to 80 psi, the improvement obtained was highly significant. The improvement from 80 to 100 psi was significant, but further pressure increases were not. The effect of pressure on sand and manure residues with the solid spray nozzle is shown in Fig. 3. A point of inflection occurs in the curve

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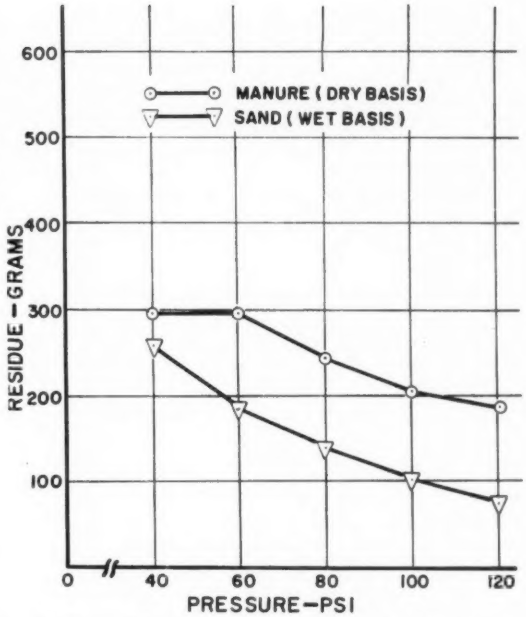

Fig. 2 The solid spray nozzle was superior (with sand) to the other three using a flat-type pattern

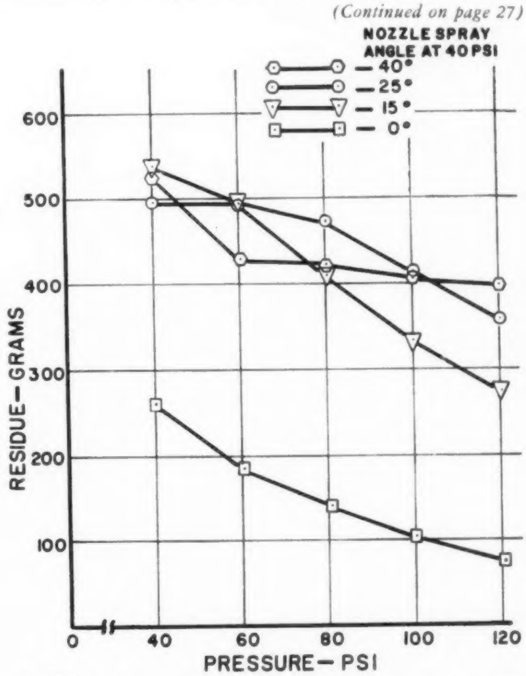

Fig. 3 Effect of pressure on sand and manure residues with the solid spray nozzle

Land Forming — An Accepted Drainage Practice

Phelps Walker Member ASAE and **J. H. Lillard** Fellow ASAE

Engineering procedures and costs for the Coastal Plain area of eastern Virginia

THERE are large areas of agricultural land in the eastern Coastal Plain area of Virginia which require an excessive amount of hand labor to obtain satisfactory drainage during the crop-growing season. This condition has been brought about by past tillage practices, changes in location of drainage ditches and other types of surface manipulation resulting in the formation of numerous depressions one to six inches deep. Because of the low infiltration rates of these soils, such depressions are sufficient to cause crop drowning in most years unless they are drained by hand labor during the crop-growing period.

Land forming is an accepted drainage practice for removing surface water in some areas of heavy soil where crops of high cash value are grown, but its application in locations where less favorable agricultural economy exists, such as are found in eastern Virginia, is not known. Results from preliminary row-length drainage studies indicate that surface grading can be used to reduce greatly the requirements for field drains and perhaps the number of lateral ditches, but the full potentiality of land forming in reducing the need for these structures has not been determined. The row length studies also indicate that smoothing of land to a uniform grade in the direction that crop rows will follow may give adequate drainage for crop production.

A comprehensive experiment is being conducted near Norfolk, Va., to determine the effectiveness of such practices in eliminating hand labor, in reducing the number of drainage ditches and in improving the quality and yield of crops.

The purpose of this report is to present the results from those phases of this experiment having to do with the engineering procedures employed and the costs of the initial land-forming operations.

Most of the research in land forming to date has been concentrated on developing procedures, techniques and machinery. Description of field procedures have been reported from Louisiana (3)* and the Southwest (1). Saveson (4) analyzed the machinery requirements for draining and forming Louisiana delta soils. Givan (2) proposed a method for computing the position and slope of the plane of balanced cuts and fills having a total cut near a minimum.

Cost estimates for land forming apparently reflect wide variations in soil and topographic conditions. Yardages of earth moved in the Louisiana delta ranged from 125 to 450 cu yd per acre at costs between 18 and 25 cents per cubic yard (3). The higher costs were associated with the smaller amounts of earth moved. Costs of grading 81,000 acres in Arizona, Colorado, New Mexico and Utah amounted to 12.3 cents per cubic yard (1).

Procedures

The area selected for forming was sufficiently large to utilize equipment which is best adapted to grading operations and to permit its efficient use. An experienced and skilled operator† was secured to operate the larger grading equipment. Operating time was recorded for each forming operation.

Plot arrangement, sizes and grading quantities are shown in Fig. 1. The larger areas, plots 3 and 4, were obtained by filling in lateral drainage ditches thereby combining two original land cuts‡ in each plot. Width of plots 1, 2 and 5 are about 200 ft each, and the two larger plots are approximately 425 ft wide. Plots 2, 3 and 4 were completely graded to provide a tilted-plane surface. Plot 5 was formed with all earth-moving done parallel to the normal direction of crop rows. Plot 1 was the control for the experiment; no land forming was performed on that area.

The soil in the experimental area is Elkton very fine sandy loam—a Coastal Plain soil derived from sandy clays and clays. The texture below plow depth is a dense silty clay. Natural slopes ranged from level to 0.5 percent. An average of 105 ft per acre of hand-dug temporary field drains have been used by the farmer annually to conduct water from the low areas into the permanent ditches.

Land-forming operations for which time was recorded consisted of the following:

Initial Plot Preparation. Plots were disked and plowed to remove ridge rows and to mix crop residue trash into soil and then disked again in preparation for surveying. A two-plow farm tractor and matching equipment were used for this operation.

Surveys and Computations. After permitting soil to settle, topographic surveys were made of each plot. Hub stakes were set on 50 x 100-ft stations (grid corners). Grades were computed by the least squares method and changes in land-surface elevations marked on hub stakes.

Paper presented at the Winter Meeting of the American Society of Agricultural Engineers at Chicago, Ill., December 1957, on a program arranged by the Soil and Water Division, and approved as a joint contribution of the agricultural engineering department, Virginia Agricultural Experiment Station and the Eastern Soil and Water Management Research Branch (SWCRD, ARS), USDA.

The authors — PHELPS WALKER and J. H. LILLARD — are, respectively, agricultural engineer (ARS, USDA) and professor of agricultural engineering research, Virginia Polytechnic Institute.

Acknowledgment: The authors express appreciation to the Caterpillar Tractor Co., and especially to its representatives, J. L. Diamond and H. D. Haynes, for machines and assistance provided for conducting the study reported in this paper.

*Numbers in parentheses refer to appended references.

†Special appreciation is expressed to J. A. Baum, land owner, and J. A. Bryant, the operator of the heavy machinery, who was on loan from the SWC Baton Rouge, La., Field Station.

‡A "cut" is an area bounded by two lateral drainage ditches and two farm access roads.

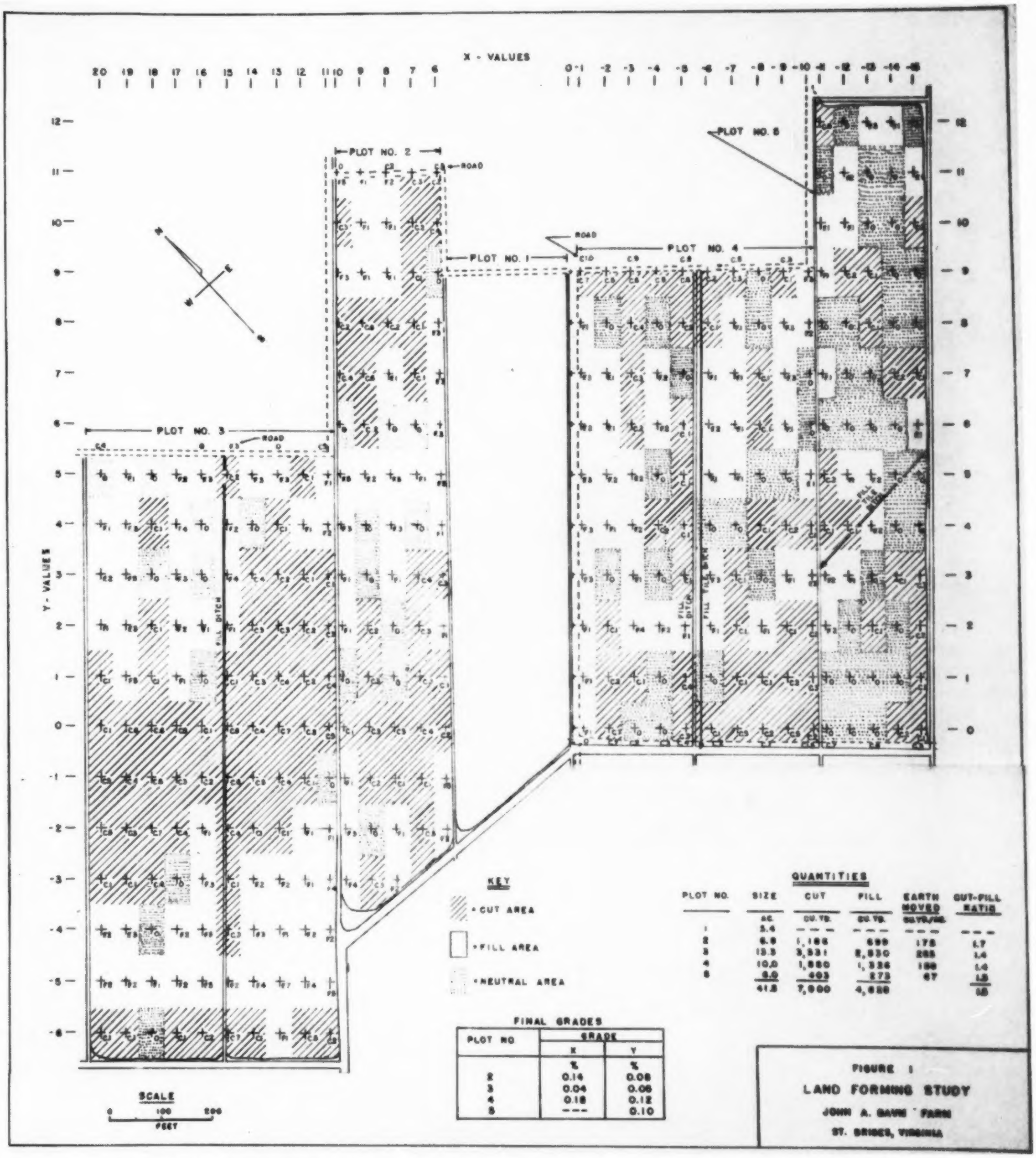

Fig. 1 Plot arrangement, sizes, and grading quantities from the eastern Virginia land-forming study

Time required for checking progress of forming was included in this operation.

Final Plot Preparation. Spoil, stumps and debris along all lateral drainage ditch banks that formed plot boundaries were pulled away from ditches with a 12-ft dozer. Ditches in the middle of plots 3 and 4 were filled. All debris was hauled from experimental areas.

Primary Forming. A 75-hp track-type tractor and 7-cu yd scraper were used to move soil and form land to within 0.1 ft of desired grade.

Finish Forming. This operation consisted of smoothing the land with a 30-ft land plane pulled by a farm tractor.

Results

The percentage of the total area of each plot which required cutting, filling, or neither was calculated from an analysis of survey data. These data, together with the earth moved per acre and the earth moved per hour for each of the formed plots, are summarized in Table 1. Plots 2, 3 and 4 (Fig. 1) were graded and smoothed in both cardinal directions and diagonally, resulting in a surface plane slop-

ing with the natural topography of the land. All grading and smoothing operations on plot 5 were done parallel to existing lateral ditches and in the same direction which subsequent crop rows will follow. With this simplified method of forming the ridged-crop rows become an integral part of the forming operation and are necessary to conduct the water to the field drains.

The similarity of the cut, fill and neutral percentage values for plots 2, 3 and 4 indicates the general uniformity of surface conditions among these areas; however, the surveys showed that the cuts on plot 3 averaged 0.30 ft, while on plots 2 and 4 the averages were 0.26 and 0.24 ft, respectively. This probably accounted for the greater amount of earth which had to be moved on plot 3. The rather wide variation in the cubic yardage moved per hour among the three plots is a reflection of the relative distribution of the cut, fill and neutral areas.

The much lower percentage of cut-and-fill areas and higher percentage of neutral area in plot 5 resulted from the different analysis of survey data which is applicable when all forming operations are done in one direction. Likewise the earth moved per acre is reduced by approximately two-thirds.

Cut, fill and haul distance data are listed in the footnote to Table 1. These values were almost constant among all plots. For the discussion in this paper "haul distance" is defined as the distance traveled with scraper loaded to capacity and not land forming in transit.

The man-hour and machine-hour requirements for the land-forming operations are summarized in Table 2. The per-acre time requirements for the various phases of the forming operations were fairly uniform for each of the four plot areas with the exception of the much lower machine-hour requirements for the primary forming of plot 5 and the higher finish forming time for plot 4. Limiting the land-forming operations to one cardinal direction in plot 5 reduced the heavy machinery requirements for primary forming by approximately 68 percent. The higher land plane requirement for finish forming for plot 4 is attributed mainly to somewhat more inefficient leveler operation since it was the first plot smoothed.

The cost per acre for each phase of land-forming treatment is summarized in Table 3, using the rates indicated in the table. These costs bear the same relationship to each other as shown for the time requirements in Table 2. Total costs of forming plots 2, 3 and 4 averaged $61.14 per acre, while the costs for treating plot 5 with forming in one direction only was $34.22 per acre. Most of the difference is accounted for by the reduction in use of heavy equipment for the primary forming operation on the latter plot.

TABLE 1. DISTRIBUTION AND AMOUNT OF EARTH MOVED IN FORMING LAND
(Baum Farm, St. Brides, Va.)

		Plot				
		Complete forming				Longitudinal forming
Item	Units	2	3	4	Avg.	5
Plot size	Acres	6.8	13.3	10.0	10.03	6.0
Portion of plot "cut"	Percent	42.5	49.2	42.0	44.57	26.2
Portion of plot "fill"	Percent	42.5	41.7	39.0	41.07	23.1
Portion of plot "neutral"	Percent	15.0	9.1	19.0	14.37	50.7
Earth moved per acre	Cu yd	175	265	188	209	67
Earth moved per hour	Cu yd	82.5	121.7	89.5	98.6	101.0

Average "cut" (range 0.26 to 0.30), 0.27 ft
Maximum "cut", 0.7 ft
Minimum "cut", 0.1 ft
Average "fill" (range 0.17 to 0.25), 0.22 ft
Maximum "fill", 0.7 ft
Minimum "fill," 0.1 ft
Maximum haul distance, 900 ft
Minimum haul distance, 50 ft
Average haul distance, 430 ft
Portion of time devoted to haul, 26 percent

TABLE 2. TIME REQUIRED FOR LAND-FORMING OPERATIONS
(Baum Farm, St. Brides, Va.)

		Plot				
		Complete forming				Longitudinal forming
Operation	Units	2	3	4	Avg.	5
Initial plot preparation	mac-hr/ac	1.71	1.70	1.53	1.65	1.47
Surveying and computations	man-hr/ac	6.27	6.11	5.85	6.08	6.02
Final plot preparation	mac-hr/ac	.44	.53	.50	.49	.53
	man-hr/ac	.88	.60	.70	.73	.67
Primary forming	mac-hr/ac	2.06	2.18	2.10	2.11	.67
Finish forming	mac-hr/ac	1.88	1.84	2.35	2.02	1.88

TABLE 3. COSTS PER ACRE FOR LAND-FORMING OPERATIONS
(Baum Farm, St. Brides, Va.)

		Plot				
		Complete forming				Longitudinal forming
Operation	Estimated operating rate	2	3	4	Avg.	5
Initial plot preparation	$ 4.50/mac-hr	7.70	7.65	6.88	7.41	6.60
Final plot preparation	$12.00/mac-hr	5.30	6.40	6.00	5.90	6.35
	$ 1.00/man-hr*	.90	.60	.70	.73	.67
Primary forming	$18.00/mac-hr	37.00	39.20	37.80	38.00	12.10
Finish forming	$ 4.50/mac-hr	8.50	8.30	10.50	9.10	8.50
Total cost of land forming†		59.40	62.15	61.88	61.14	34.22

*Labor for removing stumps and trash.
†Exclusive of cost of surveying and computations

Discussion and Interpretation of Results

Man-hour and machine-hour requirements for completely forming plots 2, 3 and 4 indicate that the original surface conditions were reasonably comparable. On these areas the machine-hour requirements were about equally divided between primary and finish forming. The land sloped in the same general direction, thus making it possible to form each entire plot to a continuous grade. In many land cuts in eastern Virginia the grade will reverse, making it impractical to establish con-

tinuous drainage in one direction for the whole area. This condition should not materially affect land-forming operations, except to make it necessary to provide drainage from the low area to drainage (disposal) ditches.

In plot 5, which received only longitudinal forming, the land slope did reverse making it necessary to install a surface field drain through the middle of the plot (Fig. 1). In this instance a 4-in. drain tile was placed under the surface drain to expedite profile drainage.

Ridged row tillage is used almost exclusively in this eastern Virginia area. Previous exploratory studies indicated that the channel between the ridged rows can be utilized effectively in surface drainage. The longitudinal forming applied to plot 5 is an effort to capitalize on those conditions by making maximum use of row drainage and minimizing the land forming required.

The cost figures given in Table 3 for the various operations in land forming show that the greatest single cost is in the primary forming operation which requires the use of heavy machinery. Even so the average total cost of \$61.14 per acre for complete land forming is not out of line with the costs of other drainage methods. Any modifications to the practice, such as those used in plot 5 to reduce heavy machinery costs, will further enhance the possibilities for this type of drainage.

Summary

A study of the engineering practices and costs of the various operations required for land forming have been completed for one large field experiment. This study is located on a heavy Coastal Plain soil (Elkton very fine sandy loam) in eastern Virginia. The results show that an average of approximately six man-hours per acre are required for surveys and computations. The complete forming operations, exclusive of surveys and computations, cost approximately \$61.00 per acre on this experiment. Where the land was formed in one direction only and the ridge-crop rows utilized as an integral part of the forming operation, the cost was reduced to about \$34.00 per acre.

Land forming is a new practice in this area and its effectiveness and limitations have not been established. This study is being continued to measure the degree of drainage attained and the effect of the practice on crop yield and quality, but further testing on a wider range of soil and crop conditions will be necessary to determine its full potentiality.

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. . . Hydraulic Manure Removal

(Continued from page 23)

for manure between 60 and 80 psi. It is suggested that this point reflects a "breaking" point, where the adhesive qualities of the manure are overcome.

By mounting a camera on the trolley, a movie film was taken to observe more closely if pressures higher than this point would be capable of overcoming the adhesive forces. At these higher pressures, the manure was observed to be lifted clear of the concrete due to the forces exerted by the water.

Physical characteristics of manure will vary depending on such factors as type of animal, dry matter content and feed. The specific minimum pressure requirements could not be stated from the limited data obtained, but it is suggested that, under most conditions, a pressure of 80 psi should perform an effective cleaning job. Whether pressures up to 100 psi should be used depends on the degree of cleanliness required. An undesirable rate of dilution may result with pressures above 80 psi.

The effect of surface roughness on cleaning effectiveness was negligible under the conditions of this experiment. This is contrary to the generally accepted view. The result may be influenced by the relatively small size of the concrete surfaces, and the fact that the manure on the slabs had no opportunity to dry out.

With the solid-spray nozzle, the general behavior of the manure and the sand was similar. Using mean residue values for each of the pressures, a significant correlation coefficient of 0.9291 was obtained between values for sand and manure. As manure is a difficult material to work with, this correlation should be encouraging for future work.

Conclusions

A nozzle with a solid-spray pattern was superior to nozzles with either cone or flat-spray patterns, in its ability to flush manure from concrete surfaces.

Using a solid-spray nozzle, increasing pressures from 60 to 80 psi resulted in a highly significant improvement in cleaning effectiveness. At 100 psi the improvement over 80 psi was significant. A pressure of 120 psi was not significantly better than 100 psi.

The effect of surface roughness on cleaning effectiveness was negligible.

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TRANSACTIONS of the ASAE

January 15 is the final deadline for ordering copies of the special Soil and Water edition of the 1960 TRANSACTIONS of the ASAE which will contain 100 pages, devoted exclusively to Soil and Water subjects. Copies are available at \$4.00 each (\$3.00 to ASAE members). Publication of the Transactions permits ASAE to nearly double the number of papers being published in a recognized indexed publication. The second edition, containing at least 144 pages of technical articles, will be published later in the year. Copies of General edition sell for \$6.00 each (\$3.25 to ASAE members). Combined price for both editions is \$8.00 (\$5.50 to ASAE members).

Some Aspects of Vibratory Fruit Harvesting

R. B. Fridley
Assoc. Member ASAE

and

P. A. Adrian

Fig. 2 Constant-displacement shaker with force and power recording equipment

Effectiveness, power required, fruit damage and tree damage are taken into consideration in searching for proper frequency, stroke length and clamp position for vibratory tree shakers

VARIOUS types of tree shakers that vibrate the tree branches to remove the fruit have been developed during the past few years. Shakers are now used commercially for some fruits with partial success; on many more fruits they are being used experimentally.

Thus far, tree shakers have been developed by somewhat of a trial and error procedure. If a particular stroke and frequency proved unsatisfactory for some reason, one or the other or both were changed. To eliminate the necessity of a trial and error procedure, the University of California in cooperation with the U.S. Department of Agriculture has undertaken a study of the fundamental principles involved in tree shaking. It is hoped that this study will lead to the development of a more efficient means of producing vibration.

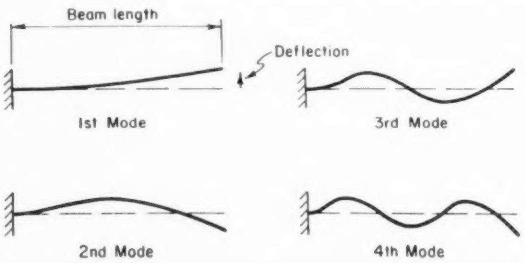

Fig. 1 Typical deflection curves of a uniform cantilever beam at the first four modes of vibration. Note the nodes (points of zero deflection) and the anti-nodes (points of maximum deflection)

Background

The basic objective in removing fruit by shaking is to accelerate the fruit so that the inertia force developed will be greater than the bonding force between the fruit and the tree. A practical method of accelerating the fruit is to vibrate the tree limbs.

Vibration of primary fruit tree limbs is in many ways similar to the vibration of a cantilever beam. Therefore, vibration characteristics of a uniform cantilever beam help to predict the possible behavior of a tree limb.

Fig. 1 shows a comparison of the deflection curves of a uniform cantilever beam at the first four modes of vibration (2)*. A mode of vibration is the vibration at a natural

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The authors — R. B. FRIDLEY and P. A. ADRIAN — are, respectively, assistant specialist, California Agricultural Experiment Station, Davis, and agricultural engineer, (ARS) USDA, Davis, Calif.

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*Numbers in parentheses refer to appended references.

frequency of the system (2). Assuming for the moment that a tree limb is a uniform cantilever beam, Fig. 1 can be studied to see what vibrations might be used to remove fruit most effectively. First, it should be recognized that fruit may be located at any point along the beam, which indicates the need of a variable-frequency shaking device because the nodes are stationary for a particular frequency. Second, a more efficient operation will result if the various modes of the natural frequency are used to advantage, since the shaker is causing the tree to vibrate in a manner that is in agreement with the natural characteristics of the tree. The problems involved in shaking at a natural frequency are: *(a)* the applied frequency must be equal to the natural frequency, and *(b)* the force should be applied at an antinode for the highest efficiency.

It may seem impractical to require that the force be applied in a particular place that might be different for every limb. However, the desirable point for force application may not be too critical and it may fall within a given range for most limbs of a particular fruit variety. It should also be noted that the *n*th frequency is not *n* times the first mode frequency but is more likely to be much higher (2, 3). For this reason it is probably most practical to use only one natural frequency. Even this would require a variable frequency device to cover the preferred mode frequency for many different limbs.

Field Tests

The primary aim of the tests was to determine the relationship of frequency, stroke, and clamp position to fruit removed, power required and forces exerted on the tree (1). Tree and fruit damage were also kept in mind.

The princple field testing done thus far has been with a constant-displacement type of tree shaker (Fig. 2). In addition, some preliminary work has been done with an eccentric mass vibrator, a schematic of which is shown in Fig. 3.

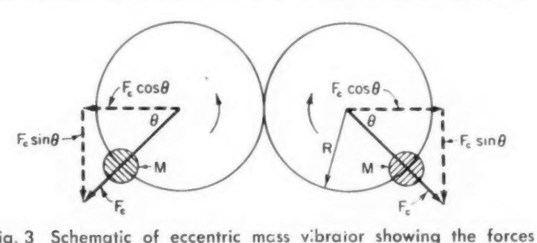

Fig. 3 Schematic of eccentric mass vibraior showing the forces generated. The force output = 2 F_c sin θ where $F_c = MRW^2$

Each mass weighs 5 lb and has an eccentricity of 2½ in. The unit is driven by a flexible shaft with a variable-speed electric motor as the power source. It should be pointed out that the results obtained with the eccentric mass shaker could be accomplished with any device that has a harmonic force output proportional to the frequency squared.

With the constant-displacement shaker, fruit removal was determined by shaking all the primary limbs of a tree with the same stroke at about the same frequency and then determining the weight of the fruit removed and the fruit not removed. The tests with the ecentric mass vibrator were very limited; only visual observations were made, with a negligible amount of fruit left in the tree.

Force and power measurements with the constant-displacement shaker were made by using strain gages in conjunction with a cathode-ray oscilloscope. The results were recorded with an oscilloscope camera.

Power measurements of the eccentric mass vibrator were made with a watt-hour meter. The forces exerted on the tree were determined in the same way as with the constant displacement device. In addition to these measurements, the stroke of the device was measured with a simple mechanical arrangement.

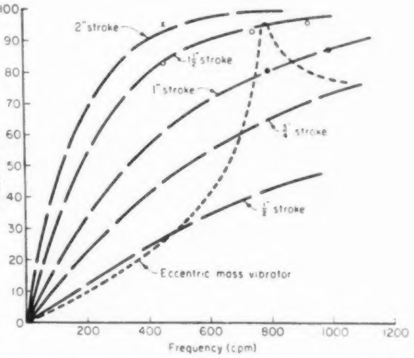

Fig. 4 Prune removal as affected by frequency and stroke. Note the typical removal versus frequency curve of the eccentric mass vibrator for a particular limb. The maximum removal occurs at a natural frequency of the limb

Fruit Removal

Fig. 4 shows the relation of frequency and stroke to fruit removal for prunes. The curves shown are based on the empirical expression:

$$\text{Percent removed} = 100 - 100\, e^{-k s^{1.5} N}$$

where s = stroke in inches, N = frequency in cycles per minute, and k = constant for a particular tree in minutes per cycle — in.$^{1.5}$. (This expression was derived from data obtained with the constant-displacement shaker.) For the curves shown, $k = 2.05 \times 10^{-3}$. During the tests on prunes, k values were found to range from 1.13×10^{-3} to 2.70×10^{-3}. High values of k are the result of having a stiff tree, very little fruit in the lower-center portion of the tree and a low bonding force between the fruit and the tree. A k of 1.13×10^{-3} with a 1½-in. stroke removes about the same percentage of fruit as a 1-in. stroke removes with a k of 2.05×10^{-3}. Statistical analysis has shown the empirical relationship to be above the one percent level of significance for the ranges of frequency (400-1100 cpm) and stroke (½ to 2 in.) used.

Preliminary trials indicate that a similar family of curves can be developed for olives. However, the exponents of s and N may be somewhat different from the values derived from prunes and the values of k seem to be greatly different from the values for prunes. Olives are more difficult to remove than prunes since more acceleration is required to overcome the bonding force and the outer portion of the olive tree is extremely limber and bushy.

With the eccentric mass vibrator, the stroke for a particular limb and a particular clamp position is a function of the frequency. If the clamp is placed about at an antinode for some natural frequency, the stroke will reach a maximum at that natural frequency. With the clamp placed about one-third of the way out on a prune limb, the stroke caused by the eccentric mass vibrator seems to reach a maxi-

mum value within the frequency range of 400 to 1200 cpm. If the stroke versus frequency curve for a particular limb is superimposed on the family of curves of a percent removed versus frequency and stroke an indication of the fruit removal versus frequency that might be expected with the eccentric mass vibrator can be obtained (Fig. 4). The presence of an optimum frequency for fruit removal with the eccentric mass vibrator was visually observed to exist in the field.

With the constant-displacement device prune removal was not appreciably affected within the range of clamp positions checked (one-half to one-fourth of the way out on the limb). However, indications are that clamp position does affect removal with the eccentric mass shaker.

Power and Force

Preliminary investigations indicated a steady increase in the power and force requirements of a constant-displacement device with an increase in frequency (1). However, further work revealed a depression in the horsepower curve (Fig. 5) and the force curve at some frequency. This depression is apparently the result of having the clamp positioned near an antinode and the shaking speed at a natural frequency. Under these conditions less force is required to achieve a given stroke. Equipment limitations prevented investigations at speeds greater than 1200 cpm. However, it can be shown that the power required for a constant-displacement vibration of a simple spring-mass system is a minimum at about the natural frequency (4). It is reasonable to assume that tree-shaking power requirements will also reach a minimum at about the natural frequency.

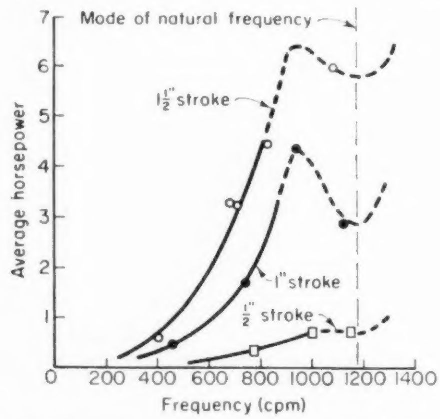

Fig. 5 Typical power requirement of a constant displacement shaker

Force versus frequency curves are not shown, but they are similar to the power curves.

When the fruit removal curves (Fig. 4) are compared with the power curves (Fig. 5) it can be seen that, in general, less power is required to obtain a given percent removal with long strokes and low frequencies. This, however, is not the entire answer. Tree damage and damage to the fruit before it is separated from the tree must be considered. Visual observations on prune trees show that tree damage increases more rapidly with an increase in stroke than with a comparable increase in frequency. The damaging of olives seems to be aggravated by long strokes that whip the limbs. Expectations are that a higher frequency with less limb movement will cause less fruit damage.

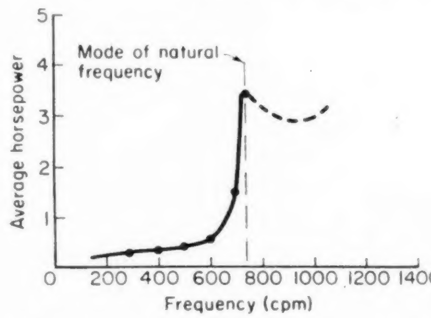

Fig. 6 Typical power requirement of the eccentric mass vibrator

Fig. 6 shows the effect of frequency on the power required for the eccentric mass shaker. With this unit, the power required increases rapidly as the natural frequency is approached. This increase is due to the increase in stroke and the consequent increase in velocity as the natural frequency is approached. Equipment limitations again prevented investigation of the power above the natural frequency, but for a simple spring-mass system it can be shown that the power required follows the trend shown in Fig. 6, (4). The assumption is again made that the power required for tree shaking will follow the same trend as the power required for the vibration of a system having a single degree of freedom.

Although the eccentric mass vibrator requires maximum power at natural frequencies and the constant displacement device requires minimum power at natural frequencies, the power for either device would be expected to be the same at a natural frequency if both devices were clamped in the same position on a limb and were delivering the same stroke. For this reason, it would not make any difference which method of vibration was used if the natural frequency of the limbs were known. However, each limb has different natural frequencies. Therefore, to take advantage of the natural frequencies a variable-speed device will be required so that one can find the natural frequency by varying the speed. By comparing the horsepower curves for the two devices, it can be seen that a minimum amount of energy would be required if the starting speed is below the natural frequency and is increased until the natural frequency is reached. It can also be seen that, on a particular limb, less energy would be required by the eccentric mass shaker since very little power is required until its speed is equal to the natural frequency.

The results on the force and power requirements discussed thus far were obtained with the clamp positioned about one-third of the way out on limbs that were about 5 in. in diameter at the clamp. Positioning the clamp closer to the tree trunk or increasing the limb size increases the power and force requirements.

The effect of having the boom of the constant-displacement shaker at various angles to the limb is shown in Figs. 7 and 8. The important point in connection with these

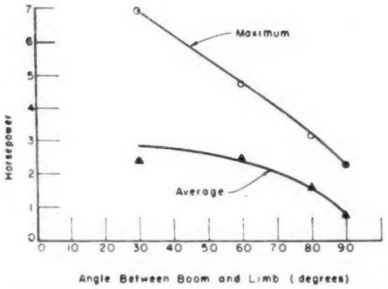

Fig. 7 Power requirements for shaking prune limbs with the constant-displacement shaker as affected by the angle of force application to the limb

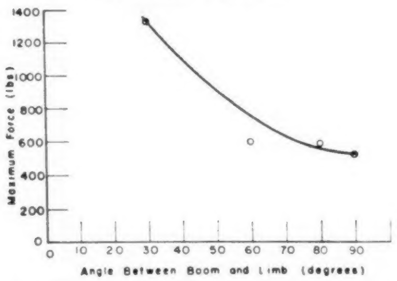

Fig. 8 Force exerted by the constant-displacement shaker as affected by the angle of force application to the limb

figures is their relation to damage done to the tree by the clamp. In addition to the fact that the force and power are both increased as the included angle between the boom and the limb is decreased, the force has a component colinear to the limb. This component is the direct cause of bark damage.

Conclusions

Selection of the optimum means of vibrating trees to remove the fruit involves a consideration of effectiveness, power required, fruit damage and tree damage. Since all these criteria are not affected in the same way by a given change in operating conditions, optimization necessitates compromises.

Apparently, the optimum frequency of operation is at a natural frequency of the system. Which natural frequency can best be used depends on *(a)* the stroke required to remove fruit at the frequency, *(b)* the power required, and *(c)* the resulting tree and fruit damage. Higher frequencies and shorter strokes seem to result in less tree and fruit damage but require more power.

The optimum clamp position is yet to be investigated. However, indications are that it will depend on the frequency used. One point that is important is that the shaker be clamped to the limb so that the force exerted is perpendicular to the limb, thereby minimizing damage to the tree.

More information is needed before specific values of optimum stroke, frequency, and clamp position can be determined. The behavior of prune trees above a frequency of 1200 cpm must be checked. The vibration of trees other than prunes obviously must be studied. The effect of various means of attachment of the fruit to the tree (with or without stems) must be investigated as well as the type of failure when the fruit separates from the tree. And finally, the possibility of using other methods of vibration, such as impact, needs to be analyzed.

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. . . Soil Stress Distribution

(Continued from page 21)

as it approached, passed over, and left the strain-gage pressure cell oriented in the *z* direction. The top curve shows stresses applied to the soil surface as measured by the track-shoe dynamometer. It is interesting to note that, as depth increased, magnitude of the stress fluctuations decreased but their presence was still definite at stresses less than 1 psi. It is known that vibration has a compacting effect on soils of low cohesion, but as yet too little is known of the influence of vibration frequency and magnitude. Since the load on the track and tire was almost equal to the factory recommendation, it can be concluded that under these conditions the 12-in. track will cause less soil compaction than the 13-38 tire.

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1960 ASAE Membership Roster

IN order that the latest changes can be made in the 1960 ASAE Membership Roster to appear in the 1960 AGRICULTURAL ENGINEERS YEARBOOK, corrections must be received by February 1. For convenience in making corrections a clipping from the 1959 roster was attached to the 1960 membership dues invoice. Please make any necessary corrections when dues are paid. Those who find it necessary to delay payment of dues beyond February 1, are requested to return the bottom of the invoice with necessary changes.

Similitude in Studies of Tillage Implement Forces

K. K. Barnes, *Member ASAE* **C. W. Bockhop,** *Member ASAE* **and H. E. McLeod** *Assoc. Member ASAE*

Developing a technique for small-scale study of implements under controlled laboratory conditions

COMPARATIVE field testing and evaluation of trial designs of tillage implements is complicated by the variable and irreproducible nature of field conditions. Lack of temporal control of field conditions also hampers fundamental studies of forces acting on tillage tools. A technique of tillage implement testing which would by-pass the problems associated with field work would avoid costly delays and yield improved results.

The U.S. Department of Agriculture has developed one such technique at its National Tillage Machinery Laboratory at Auburn, Ala., where experiments can be conducted with full scale implements under conditions that can be controlled and reproduced. However, the cost of installations of this type prohibits their wide application.

This paper reports progress in the development of a technique whereby implements can be studied at small scale under controlled laboratory conditions free from weather hazards. While full scale testing would remain essential as final demonstration of the worth of a given design, much preliminary screening of trial designs could be conducted in the laboratory. Further, fundamentals of the physical behavior of tillage tools are much more likely to be uncovered from tests conducted under controlled laboratory conditions than from field tests.

Successful use of small-scale models for tillage-implement studies depends upon proper application of the principles of similitude, which involve the use of dimensional analysis and models in studying physical phenomena. The design of these models is based upon the fact that dimensionally homogeneous equations expressing physical phenomena can be arranged into groups of dimensionless quantities, and upon the Buckingham Pi Theorem. Basic principles of similitude in engineering are discussed by Murphy (1)*.

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The authors — K. K. BARNES, C. W. BOCKHOP, and H. E. McLEOD — are, respectively, professor of agricultural engineering, Iowa State University, professor of agricultural engineering, University of Tennessee, and assistant professor of agricultural engineering, Clemson College.

*Numbers in parentheses refer to appended references.

Analysis

The first step in planning a model study is the identification of measurable physical variables which, when properly combined, will completely describe the physical phenomena under study. These variables are then grouped into a series of independent dimensionless terms, and these terms are used as the basis for design of the model.

The disk was chosen as the tillage implement to be used for the initial investigations reported in this paper, because its geometry is relatively simple and thus easily described by a few parameters as follows:

Symbol	Definition	Dimension†
D	diameter of disk	L
λ	other pertinent lengths	L
α	angle of inclination	—
β	disk approach angle	—

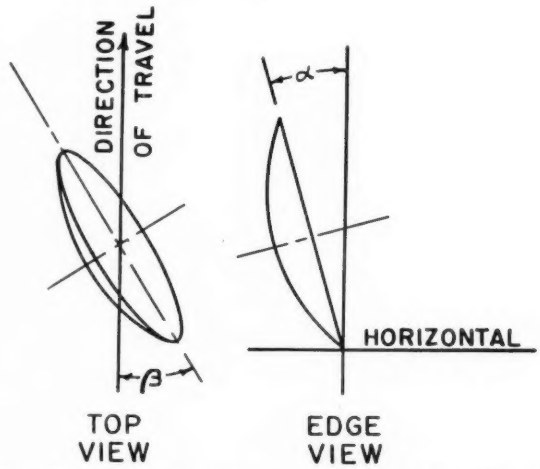

Fig. 1 The angles of inclination, α, and of approach, β, of a disk

These properties of the disk are shown in Fig. 1. The common disk is geometrically a section of a sphere cut off by a plane. The radius of the sphere is the radius of curvature of the disk. The edge of the disk is a circle, and its diameter depends upon the distance of the plane from the center of the sphere and upon the radius of the sphere. In the above list of variables, λ may be the radius of curvature,

†Notation for dimensions is: L, length; F, force; T, time; and —, dimensionless.

the distance from the center of the sphere to the plane or the thickness of the disk material. The variable to be predicted in the initial studies reported here was the draft, or that component of the soil reaction on the disk which is parallel to the soil surface and in the direction of travel. The draft was denoted as

R=resultant force, draft		F

The operating variables are

V=velocity of the disk with respect to the soil		LT^{-1}
g=acceleration of gravity		LT^{-2}

This list leaves the soil variables undefined. Two systems of soil definition were tried. The first, referred to as soil description A, depended upon the mechanical analysis of the soil. Soil description B was based upon shearing resistance of the soil.

Soil Description A. Nichols (2, 3) has presented a series of papers which suggest that the properties of soil which determine the reaction forces on tillage tools may be taken as

w=bulk volume weight (wet basis)	FL^{-3}
M=moisture content	—
c=clay content	—
μ=angle of soil-metal friction	—

Soil Description B. Payne (4) has suggested that the Coulomb theory from soil mechanics may be applied to soils subjected to the action of tillage implements. According to this theory, soil fails when the shear stress on any surface reaches a value given by

$$S=C+\sigma \tan \phi$$

where S is shearing stress at failure, σ is normal stress, C is apparent cohesion, and ϕ is angle of shearing resistance. A similar equation relates the normal stress and the tangential stress at a soil-metal interface as

$$S'=A+\sigma \tan \mu$$

where S' is tangential stress at soil-metal interface, A is apparent adhesion, σ is normal stress, and μ is angle of soil-metal friction. From these relationships it was felt that soil force reactions to tillage implements might be defined by

w=bulk volume weight (wet basis)	FL^{-3}
C=apparent cohesion	FL^{-2}
ϕ=angle of shearing resistance	—
μ=angle of soil-metal friction	—
A=apparent adhesion soil/metal	FL^{-2}

Dimensionless Terms. Application of the Buckingham Pi Theorem as described by Murphy (1) results in reduction of the variables, including those of soil description A, to the following functional relationship among dimensionless terms:

$$R/wD^3=f\,(\lambda/D,\ V^2/gD,\ \alpha,\ \beta,\ M,\ c,\ \mu) \quad [1]$$

Including the variables of soil description B in place of those from description A, the functional relationship among dimensionless terms is:

$$R/wD^3=F\,(\lambda/D,\ V^2/gD,\ \alpha,\ \beta,\ \phi,\ \mu,\ C/wD,\ A/wD) \quad [2]$$

The design of a model is based on the fact that if each dimensionless term on the right of equations such as [1] and [2] is made equal for model and prototype, the term on the left of such equations will be equal for model and prototype since the same functional relationship applies to both model and prototype. Thus, in these tillage model studies, if dimensionless quantities on the right of equation [1] or [2] are set in a model to be equal to their values in the prototype, and if the proper variables have been included, the value of R/wD^3 determined from tests of the model will be a prediction of the value of that term for the prototype.

Model Design. Model design and operating conditions for soil descriptions A and B are determined from equations [1] and [2], respectively. The subscript m indicates terms written for the model, and the lack of a subscript indicates terms written for the prototype. Using soil description A, of R/wD^3 is to equal $R_m/w_mD_m^3$, then the following equalities must be satisfied between model and prototype:

$$\lambda_m/D_m=\lambda/D \quad [3] \qquad \beta_m=\beta \quad [7]$$

$$V_m^2/g_mD_m=V^2/gD \quad [4] \qquad M_m=M \quad [8]$$

$$\mu_m=\mu \quad [5] \qquad c_m=c \quad [9]$$

$$\alpha_m=\alpha \quad [6]$$

The length scale to be used between model and prototype is given by

$$D/D_m=n$$

With this scale established, the following conditions as derived from the above relationships [3] through [9] must be satisfied and met by the model.

$$\lambda_m=\lambda D_m/D=\lambda/n \quad [10]$$

which means that any length dimension of the model disk (e.g., the radius of curvature, width and depth of cut, and thickness of the material) must be equal to that length on the prototype divided by n.

Since both model and prototype will operate in the same gravitational field, $g=g_m$, and

$$V_m^2=V^2\ D_m/D=V^2/n \quad [11]$$

Thus the model disk shall operate at a velocity equal to the velocity of the prototype disk divided by $\sqrt{n}$.

The other model design conditions under soil description A are easily met, for equations [5] through [9] simply require that the model and prototype disk be of the same material, be operated at the same angles of inclination and approach and be operated in soil of the same moisture content and clay content.

Model design and operating conditions for soil description B, equation [2], are the same as those for soil description A for those conditions derived from equations [3] through [7]; however, equations [8] and [9] do not apply. Equations [8] and [9] are replaced by

$$\phi_m=\phi \quad [12]$$

$$C_m/w_mD_m=C/wD \quad [13]$$

$$A_m/w_mD_m=A/wD \quad [14]$$

These relationships require that the angle of shearing resistance of the soil for the prototype be equal to the angle of shearing resistance of the soil for the model and that

$$C_m/w_m = c/nw \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad [15]$$

$$A_m/w_m = A/nw \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad [16]$$

Experimentation

To test the validity of the selection of variables including those of soil description A, experiments were planned using disks in two sizes, 5 in. and 10 in. in diameter. The 5-in. disk was considered the model and the 10-in. disk the prototype. These disks satisfied equation [10] in all pertinent dimensions. The 5 and 10-in. disks were each operated in several soils, and the resultant forces on the disks were measured. Measurements on the 5-in. disk were used to predict the forces which would act upon the 10-in. disk. The prediction was then checked by measurement of forces developed during operation of the 10-in. disk.

The selection of variables including those of soil description B was tested using 3, 6 and 12-in. disks which satisfied equation [10].

Equipment and Procedures. With the model design conditions specified, laboratory apparatus and procedures were developed.

The equipment includes soil boxes that ride a double track about 36 ft long. The soil boxes are 3 ft wide, 12 ft long and 9 in. deep. Four soil boxes were constructed so that four different soils could be prepared for tests. A roller chain runs the length of the track and propels the soil box which is in use. A 5 hp electric motor drives the roller chain through a variable-speed drive and a worm gear. A remote-control switch permits directional control of the movement of the soil box.

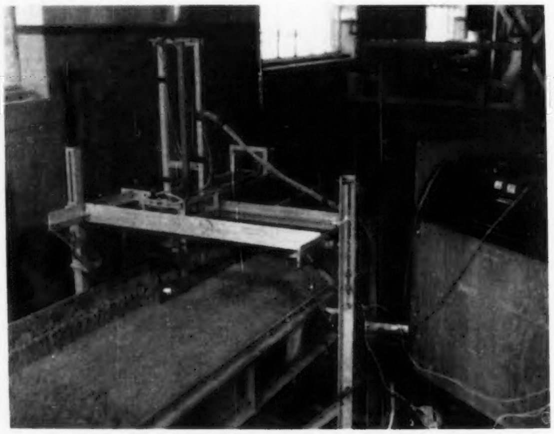

Fig. 2 Model mounted in test stand for force measurements

A test stand (Fig. 2) straddles the soil box midway along the track. The test stand consists of an angle-iron frame welded to the track and an aluminum upper frame which carries the force-sensing assembly. The aluminum upper frame pivots on two shafts attached to the angle-iron frame. The aluminum frame is held down in the operating position by a toggle device and a spring at each end. At the end of a test run, a projection attached to the end of the soil box strikes an extension of the toggle arm, allowing the extended springs to raise the disk out of the soil to clear the end of the soil box. At the same time another projecting cam opens the switch of the driving motor.

The force-sensing assembly consists of a subframe which slides laterally along the aluminum upper frame and the sensing device itself, which is suspended from the subframe by six load rings. SR-4 type C-7 electrical-resistance strain gages were used as strain-measuring elements and were mounted to measure the bending strains in the load rings.

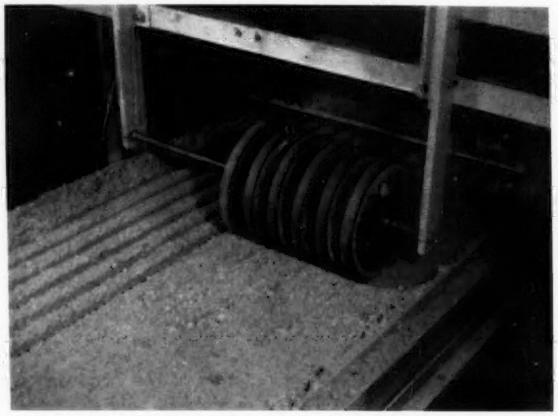

Fig. 3 Soil-fitting frame with rubber-tired compacting wheels and leveling blade

A soil-fitting frame (Fig. 3) straddles the track near the right end. Various schemes of soil fitting were tried and evaluated. The soil-fitting frame could be equipped with a variety of equipment. Most commonly used was a set of six 10-in. diameter wheels equipped with 1-in. wide, zero-pressure tires, a smooth roller 7 in. in diameter and a straight blade. Also used in compaction was a standard 5-lb Proctor hammer with a 1.5-in. thick wooden base 7¼ by 10½ in. attached.

The most successful soil-fitting procedure included the following steps: The soil was thoroughly mixed by hand tools and pulled to a pile at one end of the box. Soil was then raked down from the pile and toward the vacant end of the box and pulled upward to the desired level. With the leveling blade in position on the soil-fitting frame, the box was moved under the blade to strike off to a level soil surface. The soil was then compacted with the 10-in. rubber-tired wheels. Eight passes were made with the wheels running to a desired depth to give complete coverage of the surface. The leveling blade was then used to strike off the ridges of loose soil left by the wheels. The soil was then compacted with the Proctor hammer and attached base, and again struck off or rolled with the smooth roller to a level surface.

Soil bulk specific weight was determined by removing a soil core with a sampling tube, measuring the volume of the remaining hole with a balloon-type volume meter and weighing the core removed. The soil core removed was oven-dried for moisture determination. These measurements were made through the depth of implement operation intended in subsequent tests.

Fig. 4 Torsional shear measuring device with electric motor drive and electrical resistance strain gage torque-sensing element

Soil-shearing resistance and frictional properties were measured with a torsional device of the same principle as that described by Payne and Fountaine (5). The torque application and sensing assembly shown in Fig. 4 was used to measure the torque required to twist off a short cylindrical column of soil.

Four soils were used in these experiments to provide a range of soil properties. These soils and some of their properties are tabulated in Table 1.

TABLE 1. SOILS USED IN TILLAGE IMPLEMENT MODEL STUDIES

Soil	Source	Percent <2 micron, clay	Percent >50 micron, sand
Masonry sand	Commercial	1.5	96.2
Ida silt loam	Western Iowa Exp. Farm, Castana, Iowa	15.6	11.7
Colo silty clay loam	Squaw Creek bottom, Ames, Iowa	31.4	26.1
Luton silty clay	Luton Soil Type Exp. Farm, Sloan, Iowa	51.2	4.6

After the soil had been fitted, the disk to be tested was placed in operating position, but free of soil so that the oscilloscope could be balanced. The soil box was then set in motion and the strains of the load cells recorded. Records were made for determination of forces in three directions (draft, vertical, and transverse); however, only the draft results are discussed in this paper.

Tests Based on Soil Description A. The 5-in. disk and the 10-in. disk were operated in the same soil condition, and in accordance with the requirement

$$V^2_m/g_mD_m=V^2/gD$$

in which terms with the subscript m refer to the 5-in. disk and terms without a subscript refer to the 10-in. disk. The 5-in. disk was operated to cut a furrow 2 in. wide and 1⅞-in. deep; the 10-in. disk, 4 in. wide and 3¾ in. deep. Both disks were set at 0-deg angle of inclination and a 45-deg disk angle. Each disk was operated through the length of the soil box twice for a record of draft measurement. These pairs of runs with each disk were conducted at four different values of V^2/gD and at each of several soil-moisture levels.

Tests Based on Soil Description B. Examination of design conditions [15] and [16] show that they cannot be satisfied if soil is to be used as the working media. Condition [15] states that the ratio of apparent cohesion to volume weight for the model soil must be equal to $1/n$ times that ratio for the prototype soil. A similar relationship is required by condition [16] for the term involving apparent adhesion. However, the two soils have the same angle of shearing resistance, and condition [5] which applied to both analyses required the same angle of soil-metal friction. It appears unlikely that soil materials could be located that could satisfy all of these conditions.

Therefore, tests and evaluation based on soil description B proceeded on the basis of model distortion. A distorted model is by definition one which does not satisfy all of the design conditions. An estimate of the effect of a given degree of distortion on the model prediction must be obtained and applied to correct the prediction.

Design conditions [13] and [14] are rewritten as

$$C_m/w_mD_m=\gamma C/wD \quad . . . . [17]$$

and

$$A_m/w_mD_m=\eta A/wD \quad . . . . [18]$$

where γ and η are distortion factors. The functional equation for the model could then be written:

$$R_m/w_mD_m^3=F(\lambda/D,\ V/gD,\ \alpha,\ \beta,\ \mu,\ \phi,\ \gamma C/wD,\ \eta A/wD) \quad . . . . [19]$$

and the relation between model and prototype is

$$R/wD^3=\delta\ R_m/w_mD_m^3 \quad . . . . [20]$$

where δ is the prediction factor, a function of the distortion factors. The distortion factors must be measured and from them the prediction factor determined which will predict with reliability the dependent variable in equation [20].

Tests were conducted with 3, 6, and 12-in. disks over a wide range of distortion factors in all four soil types and over a range of moisture contents and degrees of compaction.

All three disks were operated in each combination of soil type, moisture content and compaction. The 3-in. disk was operated at a depth of ¾ in., the 6-in. at 1½ in. and the 12-in. disk at 3 in. Shear strengths were measured at one-half of the depth of cut of each disk. The velocity dimensionless parameter was held constant and the draft measured.

This procedure yielded data from which γ, η and δ could be calculated for three model-prototype situations, (3-in. model to 6-in. prototype, 3-in. model to 12-in. prototype and 6-in. model to 12-in. prototype) in a range of soil conditions. Distortion factors and the prediction factor were calculated from equations [17], [18], and [20] rearranged to give

$$\gamma=n(C_m/C)\ (w/w_m) \text{ since } D/D_m=n$$

$$\eta=n(w/w_m) \text{ since } A_m=A \text{ and } D/D_m=n$$

and

$$\delta=R\ w_m/R_m\ wn^3$$

The apparent adhesion was not found to be significantly different from zero; thus the distortion factor η was eliminated. The distortion factor γ was found to be significant, and the prediction factor was found to related to γ by

$$\delta=0.580-0.0685\ \gamma$$

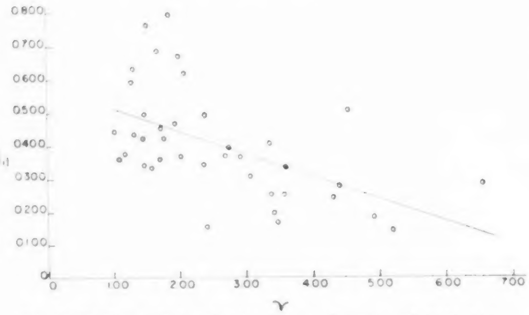

Fig. 5 Draft prediction factor, δ, as a function of distortion factor, γ

as shown by Fig. 5. The regression coefficient is significant at the 0.01 level. However, there is a definite possibility that δ is a function of some of the other pi terms as well as of γ. This possibility has not been investigated.

The prediction-distortion relationships were then used in tests of ability to predict draft from soil description B. These tests were run in Ida silt loam, Colo silty clay loam and sand with the 3, 6, and 12-in. disks operated at ¾, 1½ and 3 in. respectively, and otherwise as described for soil description A.

Results

The basic evaluation of the model technique rests in comparison of R/wD^3 from tests of the prototype with $\delta\ R_m/w_mD_m^3$ or $R_m/w_mD_m^3$ from tests of models. If the design of the model has been valid, these terms should be identical for tests in which the independent dimensionless terms for the prototype were respectively equal to corresponding dimensionless terms for the model disk or in which distortion has been recognized and properly evaluated.

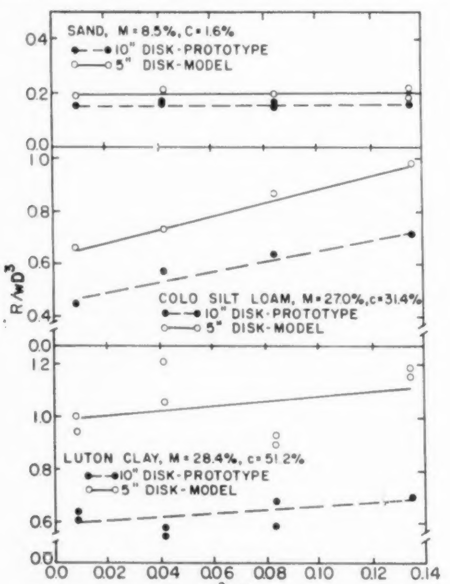

Fig. 6 Typical model-prototype comparisons from tests with design conditions based on mechanical analysis of the soil

Fig. 6 shows typical model-prototype prediction for the four soils as determined using soil description A. If prediction were perfect, the two lines on the plots would be coincident. These tests indicated good predictions at low clay contents but relatively unsatisfactory predictions at higher clay contents. This fact pointed to probable inadequacies in the system of soil characterization which involved clay content.

Results for tests designed to evaluate the analysis based on soil description B are shown in Figs. 7, 8, 9, 10, and 11.

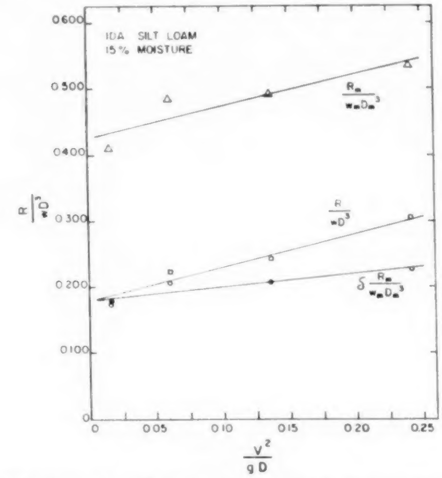

Fig. 7 Results with a 3-in. model and a 6-in. prototype from tests in Ida silt loam with design conditions based on shear properties of the soil

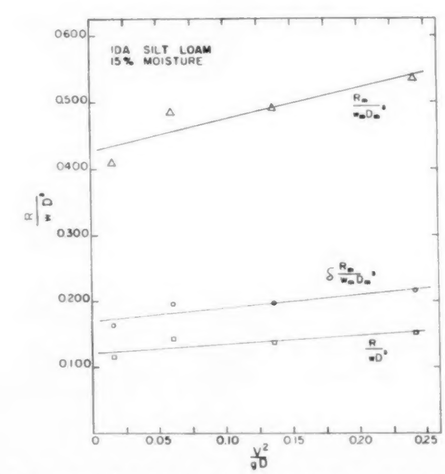

Fig. 8 Results with a 3-in. model and a 12-in. prototype from tests in Ida silt loam with design conditions based on shear properties of the soil

In each figure the value of $R_m/w_mD_m^3$, $\delta\ R_m/w_mD_m^3$ and the experimental values of R/wD^3 are shown for comparison. It is apparent from the figures that introduction of the prediction factor was of great benefit in refining the predictions.

The distorted model approach using shear properties of soil appears to give a more precise prediction than the ap-

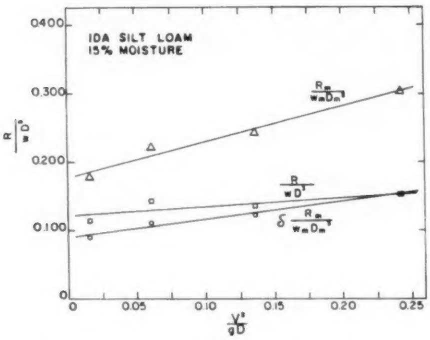

Fig. 9 Results with a 6-in. model and a 12-in. protoype from tests in Ida silt loam with design conditions based on shear properties of the soil

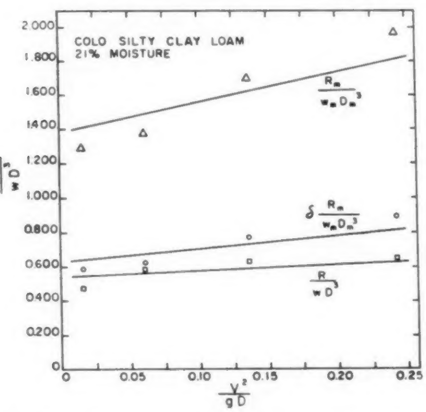

Fig. 10 Results with a 3-in. model and a 6-in. prototype from tests in Colo silty clay loam with design conditions based on shear properties of the soil

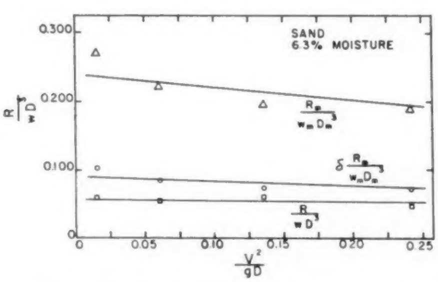

Fig. 11 Results with a 3-in. model and a 12-in. prototype from tests in sand with design conditions based on shear properties of the soil

proach based on the mechanical analysis of the soil. The data from measurements of soil properties are quite variable. This seems to be an inherent property of soil, but perhaps improved soil fitting and methods of measurement can minimize this problem. Another factor which has not been accounted for in this analysis is the variation in shearing resistance with rate of shearing strain. Rowe and Barnes (6) have shown that this is an important factor in the increase of draft with increasing speed of tillage implements. Since models must be operated at speeds different than prototypes, the shearing resistance encountered by the two must be different. This results in failure to satisfy the design condition of equation [12]. Thus shear values should be measured at the actual rates of shear of the prototype and model, respectively. There is reason to hope that recognition of this factor will refine predictions.

Example Applications

A limited amount of work was done to illustrate applications of the model technique in tillage implement investigations. There are two types of predictions which may be desired in practice. One type is the prediction of actual values of forces which may be encountered in field situations, the other is the prediction of optimum design conditions based on a given criterion. A simple example of each was tested.

Prediction of a Force Under Field Conditions. One set of field tests was run to demonstrate the use of similitude in predicting a field force. These tests were based on soil description A. Three runs were made in the laboratory with the 10-in. model in Ida silt loam to obtain a prediction of draft for the field test. The field test was conducted with a two-bottom, 26-in. disk plow. The length scale between model and prototype was:

$$D/D_m = 26/10 = 2.6$$

The operating depth, width, etc., of the model and prototype were as follows:

Prototype	Model
Diameter—26 in.	10 in.
Furrow depth—5.5 in.	2.11 in.
Furrow depth—12.7 in.	4.88 in.
α—22½ deg	22½ deg
β—42 deg	42 deg
μ—0.25	0.51
M—18.6 percent	13.2 percent
c—18.6 percent	15.6 percent
w—118 lb per cu ft	76.7 lb per cu ft
V^2/gD—0.040	0.040

All pertinent dimensions were adjusted so that the model was geometrically similar to the prototype. All independent pi terms in the model were the same as the prototype except the moisture content, the clay content and the coefficient of friction. There was a difference of 3 percent in clay content in the two soils. There probably was little effect due to this small difference, but the prediction would probably be a little low, if there were an effect.

Data from studies of the influence of moisture content on R/wD^3 were used in adjusting for the effect of the difference in moisture content between the model soil and prototype soil.

Information on the contribution of soil-metal friction to the draft of a rotating disk is not available. It has, however, been regarded as "small".

The average predicted value was

$$R_m/w_mD_m^3 = 0.373$$

The adjustment for moisture content resulted in adjusted

$$R_m/w_mD_m^3 = 0.524$$

(Continued on page 42)

Factors Affecting Temperature Gradients and Freezing Rates in Poultry Carcasses

John E. Nicholas
Fellow ASAE
and
Joseph D. Hovanesian
Assoc. Member ASAE

Air blast and immersion freezing compared in interest of improved quality control

RAPID acceptance of frozen poultry and abundant availability stimulate interest in quality control from producer to consumer. Data exists on methods of freezing packaged and unpackaged poultry in still and in moving air, and by immersion in brine or other liquid media. Present advances in technology, however, create demand for refinement of present techniques.

In searching for improvement in quality of food products, particularly those which may be highly perishable, investigators use constantly changing techniques. The high speed and quality of modern instrumentation provide the investigator with the operational flexibility and ability to obtain significant data simultaneously from multiple sources in the study of relevant factors associated with problems under investigation.

The investigation reported here was initiated in order to study the *temperature gradients* and freezing rates of large poultry carcasses as measured at specific but symmetrical locations. Gradients may be defined as differences in temperature existing at several specific locations at the same instant during the cooling or freezing period.

In the cooling and freezing of a product, with all the other factors the same, heat transfer is a function of surface area exposed per unit mass. Large poultry carcasses have relatively small surface areas in comparison with 2 or 3-lb friers. This results in larger temperature gradients in larger carcasses. Their lower rates of cooling and freezing indicate greater refrigerating capacity requirements.

Procedure

Freshly dressed, eviscerated poultry carcasses were prepared for freezing tests by being chilled in water and allowed to cool for 12 hr for ease of handling and uniform carcass temperature. The central cavities of certain carcasses were then filled with sufficient giblets so that almost no air space remained. The carcasses were cut into approximately symmetrical halves with a band saw, and thermocouples placed at the positions indicated in Figs. 1, 2, and 3. Maximum distance between any two adjacent thermocouples was less than 2 in. The spacing was relatively accurate since the middle position of each carcass was exposed when locating the couples. After insertion of the thermocouples, the other half of each carcass was replaced and matched, securely tied, and trussed. The halves of each carcass were sewed up and

Air Blast

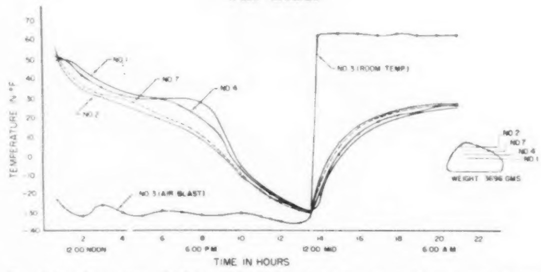

Fig. 1A Freezing 3696 g (8.1 lb) chicken in —30 F "air blast." At the center couple (No. 1) the carcass froze at the end of 8 hr. There was a 22-deg temperature differential between couples No. 1 and No. 2 located ¼ in. deep in breast meat. The curves on the right of Figs. 1A, 1B, 2A, and 2B show rates of thawing in room temperature but independent of the method of freezing

Air Blast

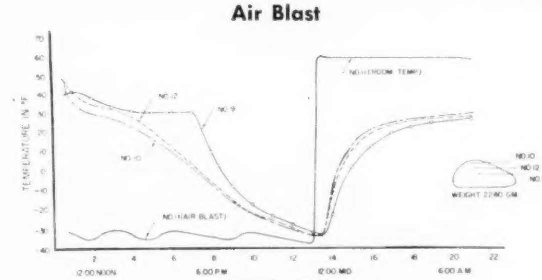

Fig. 2A Freezing 2240 g (5 lb) chicken by "air blast" at —30 F. At the center couple (No. 9) the carcass froze at the end of 7 hr. There was a 30-deg temperature differential between (No. 9) center and (No. 10) located ¼ in. deep in breast meat

stitched around their entire periphery. Carcasses were then placed in cry-o-rap bags and the cry-o-vac process used. In this process the air around the carcass is removed. The film is shrunk taut around the carcass by dipping the bagged carcass into a vat of 190 F water before freezing.

Care was exercised in all these chores to assure no dislocation of the couples from their intended positions.

Air Blast Freezing

Three carcasses weighing 3696 g (8.1 lb), 2485 g (5.5 lb), and 2240 g (5 lb) respectively were recorded automatically and compared with those of three similar carcasses

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The authors — J. E. NICHOLAS and J. D. HOVANESIAN — are, respectively, professor emeritus (deceased), and assistant professor of agricultural engineering, the Pennsylvania State University, University Park.

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frozen in a −10 F moving liquid. A Brown recorder was used.

Figs. 1A and 2A show the temperature gradient of two poultry carcasses in moving air at −30 F and subsequent thawing at room temperature. The 8.1 lb carcass, Fig. 1A, completed crystallization at the end of 8 hr with a maximum temperature gradient as freezing ended of 22 F. The 5.0 lb carcass, Fig. 2A, froze at the end of 7 hr with a 30 F temperature differential.

Immersion Freezing

Figures 1B and 2B show comparative freezing in moving liquid propylene glycol at −10 F. The time required for the 8.8 lb carcass to complete the zone of maximum crystal

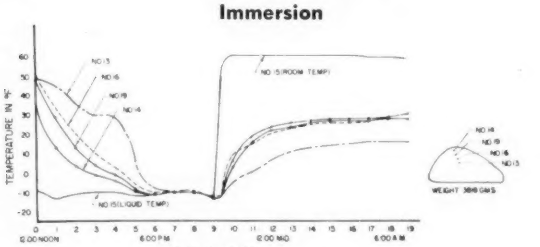

Fig. 1B Freezing 3818 g (8.8 lb) chicken in −10 F propylene glycol, by direct immersion. At the center couple (No. 13) the carcass froze at the end of 4 hr. There was a −34 deg temperature gradient between the center couple (No. 13) and (No. 14) located ¼ in. deep in breast meat

formation was 4 hr, while the 5.5 lb carcass froze at the end of 3 hr. The temperature gradient at the time of complete crystallization was 34 F in each carcass.

Fig. 3 shows the temperature gradient in a large turkey carcass at six points ranging from within a quarter inch of the outside periphery to the approximate geometrical center. The breast meat near the surface was cooled rapidly, resulting in a 10 F temperature differential at the end of 1½ hr. This differential decreased to almost zero as the varying depths of the carcass reached different stages of crystallization near 30 F. At the end of 4 hr the breast meat completed crystallization. The temperature gradient, however,

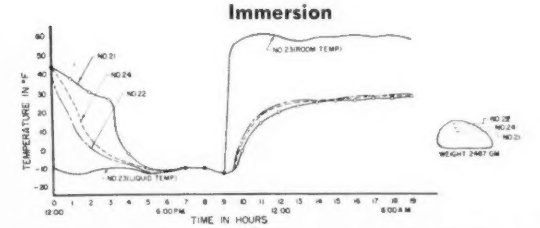

Fig. 2B Freezing 2487 g (5.5 lb) chicken in −10 F propylene glycol, by direct immersion. At the center couple (No. 21) the carcass froze at the end of 3 hr. There was a 34-deg temperature differential between the center couple (No. 21) and (No. 22) located ¼ in. deep in breast meat

increased to a maximum of nearly 20 F at the end of 7 hr when the center of the carcass completed the zone of maximum crystal formation. The differential then became smaller as the carcass temperature approached uniformity with the temperature of its surrounding liquid. Correspondingly the liquid, initially at −23.7 F, increased to a temperature of −20 F in 1½ hr and then decreased to −22 F at the end of 3½ hr, where it remained constant for the duration of the test.

Determining Freezing Temperature

As shown in Figs. 1, 2, and 3 the slope of the curves approaches zero at or near the temperature of 30 F. This was especially noticeable in the larger carcasses and in the centers of the smaller ones. Near the surface of the large carcass and in those of less mass the temperature drop was more rapid. In reality the zone of crystallization is completed in so small a time interval that it does not show up on the graph. The well defined curves, however, indicate that the freezing temperature of poultry is approximately 30F.

Immersion Versus Air Blast

Comparison of Figs. 1A and 1B and 2A and 2B shows that crystallization occurs more rapidly in direct immersion freezing than in moving air even though the air blast temperature is 20 deg lower than the liquid temperature. The carcasses frozen in −30 F air blast completed crystallization at the end of 7 and 8 hr, respectively. Those frozen by liquid immersion had crystallized at the end of 3 and 4 hr, respectively. The carcasses frozen in −30 F air blast required 4 hr longer to complete crystallization than carcasses of approximately equal weights frozen by liquid immersion, at −10 F. This indicates that liquid immersion is a more efficient and faster method of freezing than is air blast, and larger temperature gradients prevail.

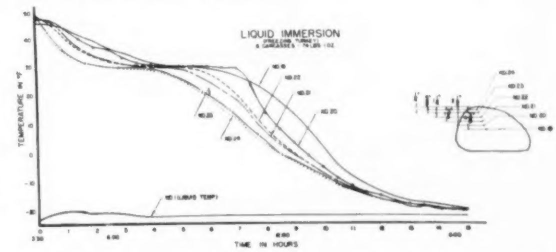

Fig. 3 Freezing an 18.5 lb turkey in −22 F proylene glycol, by direct immersion. (One of six carcasses) Center (Couple No. 19) froze at the end of 7 hr. There was a 19-deg temperature gradient between the center couple (No. 19) and (No. 14) located ¼ in. deep in the breast meat

The evidence also shows that crystallization of the center of the carcass is delayed considerably as carcass size is increased. As shown in Figs. 1A and 2A and 1B and 2B, time of freezing increased 1 hr in both methods as the mass of the carcasses increased from approximately 5 to 8 lb. The 18-lb turkey frozen at −22 F required 3 hr longer than the 8-lb chicken frozen at −10 F when both were frozen by liquid immersion. This suggests that larger carcasses require longer periods to complete crystallization even if frozen at the same temperature by the same method.

Variations in Cooling Rates

Figs. 1, 2, and 3 indicate that the rate of heat removal from the center increases after surface freezing occurs, indicating that α, thermal diffusivity, changes with the state-point of the product.

Summary

Large temperature gradients exist in large masses frozen either by air blast or by direct immersion. Although time

(Continued on page 42)

Measuring Soil Moisture Tension

by the Plaster of Paris Electrical Resistance Block Method

George Bouyoucos

THIS paper presents a new calibration on the plaster-of-paris electrical-resistance block method for measuring soil moisture under field conditions. This new calibration is based on the well-known principle of moisture tension or suction. In this new calibration the blocks are calibrated to read directly in atmospheres of moisture tension or suction. Heretofore the blocks have been calibrated to read directly in percentage of available water in the soil. It is to be emphasized here, however, that the calibration in tension is not intended to replace the present calibration in percent of available moisture, but rather to supplement it. In other words, it is an additional calibration and available to those who may wish to use it.

Procedure and Calibration

The electrical resistance of the plaster-of-paris blocks was calibrated against moisture suction by using the pressure-membrane technique of Richards (1)*. A somewhat similar study was made by S. J. Bourget, D. E. Elric and C. B. Tanner (2).

An Instrument News Contribution. Articles on agricultural application of instruments and controls and related problems are invited by the ASAE Committee on Instrumentation and Controls, and should be submitted direct to Karl H. Norris, instrument news editor, 105A South Wing, Administration Bldg., Plant Industry Station, Beltsville, Md. This paper is a contribution of the soil science department, Michigan State University, and is authorized for publication in AGRICULTURAL ENGINEERING as Journal Article No. 2493.

The author — GEORGE BOUYOUCOS — is professor emeritus of soil science, Michigan State University, East Lansing.

Acklowledgment: The author expresses his appreciation to Dr. Sterling Richards, University of California, and to Dr. Earl Erickson, Michigan State University, for assistance in connection with the new calibration presented in this paper.

*Numbers in parentheses refer to the appended references.

TABLE 1. ELECTRICAL RESISTANCE OF PLASTER-OF-PARIS BLOCKS AT VARIOUS PRESSURES

Pressure, atmospheres	Electrical resistance, ohms
1/2	730
1	1,780
2	5,600
3	13,000
5	42,000
10	101,000

The procedure consisted of saturating the blocks in a soil suspension and then completely covering them with a thin layer of soil in the form of mud. Such a layer of soil acts as a shield and minimizes errors from side or stray currents when the blocks are placed on the pressure membrane. Special care was taken to leave the blocks in the chamber long enough for equilibrium to be attained. The blocks used were of the latest type; they had stainless steel screen electrodes and were impregnated with nylon resin. The results obtained on the electrical resistance of the blocks subjected to various pressures are presented in Table 1. The electrical resistance values are the averages of four blocks for each single pressure and are corrected to the temperature of 75 F.

Moisture Meter

The moisture meter currently used for measuring the percentage of available moisture in soils (3) has two scales on its dial; one reads in percentage of available moisture, the other in ohms resistance. The ohms resistance scale can be used to measure the moisture suction as shown in Table 1 and in Fig. 1. In addition to the meter, the soil bridge

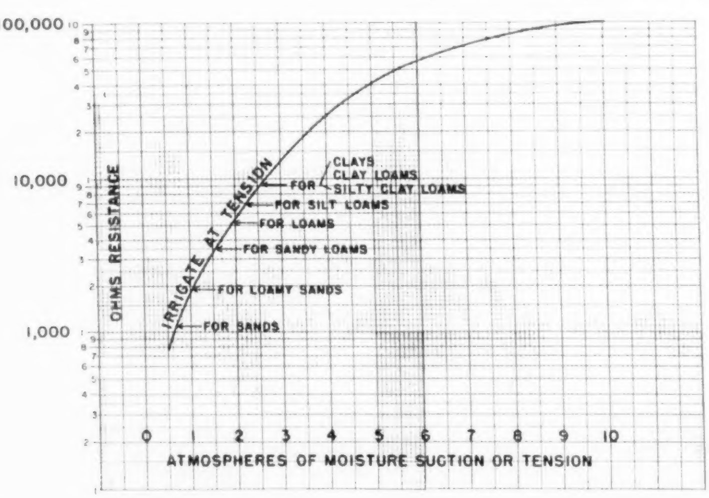

Fig. 1 Calibration in terms of atmospheres of soil moisture tension or suction

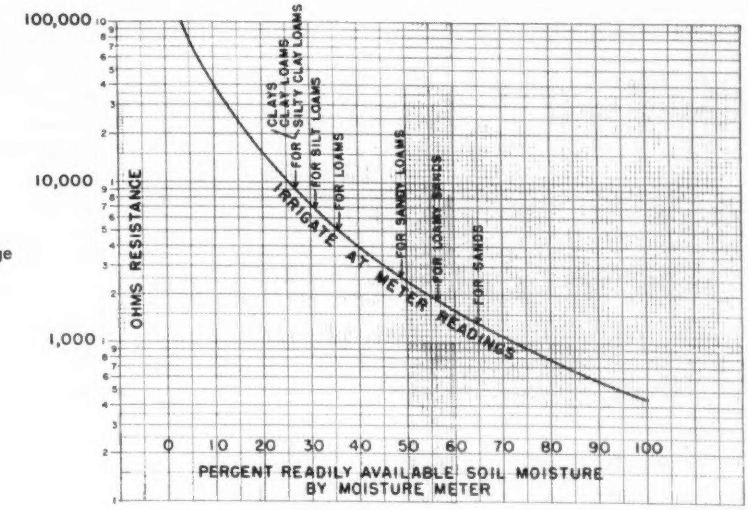

Fig. 2 Calibration in terms of percentage of available soil moisture

(4) which reads from 0 to 5,000,000 ohms, is suited for measuring the moisture suction up to the wilting point (15 atmospheres) and beyond.

Temperature Correction

The electrical resistance of the blocks is moderately affected by temperature variations. For practical purposes in field work, these variations can be ignored, especially if the readings are taken about the same time of day. For scientific work, however, temperature should be reduced to a common basis. This can be easily done by the slide rule technique (5). The temperature in this case can be measured by a thermistor, using the meter or the bridge, as measuring instruments.

Salt Effects

Since the moisture suction in the new calibration is measured by the electrical resistance of the blocks, any unfavorable salt effects on the electrical resistance will be reflected on the moisture suction values.

The problem of salts as affecting the plaster-of-paris electrical resistance method has received much attention and study. The following are the latest conclusions:

Various researches (6, 7, 8) have shown that salts in moderately high amounts, especially in the heavier types of soil, relatively high in organic matter content, do not introduce a significant error in the block resistance, nor, therefore, in the new moisture suction calibration. For very saline soils, however, the gypsum method is not recommended. In such abnormal situations no known field method works entirely satisfactorily.

Comparison of the Two Calibrations for Irrigation Purposes

The moisture suction calibration is shown in Fig. 1 and the percentage of available water calibration is shown in Fig. 2.

The most obvious and prominent fact to be observed, in the two charts, is that in both calibrations each textured soil is irrigated at different levels of moisture tension, or percent of available water. This, of course, is due to the factor of water release and to the water reserve, both of which vary in the different textured soils.

The question arises as to which one of the two calibrations is more useful for the farmer in his irrigation practices.

It is believed that the calibration in terms of percentage of available water in soils is more useful. It seems to be more meaningful, tangible, direct and informative for the farmer.

There are now two different calibrations for the gypsum method and therefore two available choices.

Summary

The plaster-of-paris electrical resistance block method was originally calibrated to read directly in percentage of available moisture in soils. It is now calibrated to read also in atmospheres of soil moisture tension or suction.

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. . . Similitude in Studies

(Continued from page 37)

Since the model and prototype were similar, the prediction for the 26-in. disk was

$$\text{adjusted} \quad R_m/w_m D_m^3 = R/wD^3 = 0.524$$

The average measured draft in the field test was 1,599 lb or 799.5 lb per disk. Therefore, the actual value of R/wD^3 for the field test was $R/wD^3 = 0.665$.

The predicted value is below the actual value but is reasonable for the prediction of a draft of a field implement.

The 26-in. disk plow was operated in a stubble field that had a heavy growth of grass and a heavy root development. The model was operated in a soil free of all vegetation, and prediction from such a soil condition can be expected to be low.

The practical significance of the difference in the predicted value and field results can be obtained by converting the predicted value for R/wD^3 into pounds of draft. Thus:

$$R = (0.524)\ (wD^3)$$
$$= (0.524)\ (26/12)^3\ (118) = 630 \text{ lb}$$

The draft in the field test was 799.5 lb. Thus, the difference is 169 pounds.

Several differences in operating conditions between the model and prototype and their qualitative effect on the precision of the prediction have been mentioned. Refinement of the technique by application of soil description B and development of better understanding of the influence of soil characteristics on tillage forces should improve predictions of this type.

Prediction of an Optimum Design Condition. An example of this type of prediction is given by the problem of determining the disk-approach angle which will result in minimum draft. This is illustrated by tests using the 5-in. disk as a model and the 10-in. disk as a prototype, again based on soil description A. Each disk was operated at several disk approach angles. Results are given in Fig. 12. The

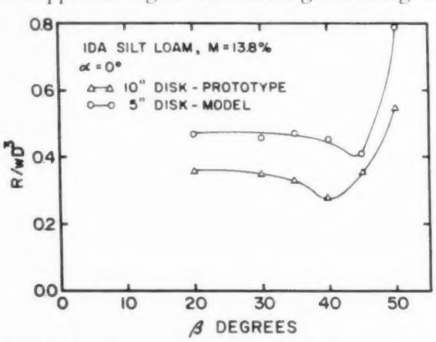

Fig. 12 Model-prototype comparison illustrating prediction of an optimum (disk approach angle for minimum draft)

minimum value of R/wD^3 for both disks fell within the same 10-deg increment of disk angle. More detailed examination of this increment would be needed to determine precision of the prediction. However, this is an example of use of the model technique where ability to precisely predict the magnitude of a force is not essential.

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. . . Poultry Freezing Rates

(Continued from page 39)

required for freezing poultry is dependent upon weight of carcass, no direct correlation seems to exist between size and temperature gradient – the 5.5 and the 8.1 lb carcasses both have the same temperature gradient when frozen in –10 F liquid.

Since different temperatures were used for freezing with moving air and moving liquid, a direct comparison cannot be made between the two processes. However, the low heat transfer properties of air were demonstrated very well. The time of complete crystal formation was longer for air at –30 F than for liquid at –10 F.

This evidence suggests to the designer that ability to withdraw heat from a material depends primarily upon ratio of mass to surface of product exposed. Freezing of the center is delayed as the mass of material becomes greater.

TABLE 1. COMPARISON OF FREEZING RATES AT DIFFERENT LOCATIONS FOR VARIOUS SIZED CARCASSES IN AIR BLAST AND IMMERSION METHODS OF FREEZING

Freezing media and temperature	Carcass size	Thermocouple number	Thermocouple location, in. from periphery	Time required for crystallization at specified location
Air Blast	3696 g	2	¼	3 hr
at –30 F	(8.1 lb)	7	1	4 hr
		4	1½	6 hr
		1	3¼ center	8 hr
	2487 g	6	¼	1½ hr
	(5.5 lb)	8	1	3½ hr
		5	1½ center	7 hr
	2240 g	10	¼	1½ hr
	(5.0 lb)	12	1	3½ hr
		9	1½ center	7 hr
Brine	3818 g	14	¼	¼ hr
(propylene	(8.8 lb)	19	1	1 hr
glycol)		16	1½	1¼ hr
at –10 F		13	3½ center	4 hr
	2557 g	18	¼	¼ hr
	(5.6 lb)	20	1	1 hr
		17	1½ center	3¼ hr
	2487 g	22	¼	¼ hr
	(5.5 lb)	24	1	1 hr
		21	1½ center	3 hr
Brine	18.5 lb	24	¼	4 hr
(propylene		23	⅝	4 hr
glycol)		22	1¼	5¼ hr
at –22 F		21	1¾	4¾ hr
		20	2½	7 hr
		19	4⅜	7 hr

TECHNICAL PAPER ABSTRACTS

Following are brief reviews of papers presented at ASAE meetings or other agricultural engineering papers of which complete copies are available. ASAE members may obtain copies of these papers without charge by returning order forms supplied upon payment of membership dues. Nonmembers, and members requesting more than 10 copies, may purchase papers at 50 cents each to cover carrying charges from the American Society of Agricultural Engineers, St. Joseph, Mich.

Mechanizing the Peanut Crop in Georgia—Tillage Through Harvesting and Curing, by James L. Shepherd, head, agricultural engineering dept., Georgia Coastal Plain Experiment Station, Tifton. Paper presented at the Annual Meeting of ASAE at Cornell University, Ithaca, N. Y., June 1959, on a program arranged by the Power and Machinery Division. Paper No. **59-136.**

This paper covers the studies made during a research and development project from 1946 through 1954, with objectives of fully mechanizing peanut production and harvesting. These studies were concerned primarily with the Spanish and runner varieties of peanuts, which were most common in the area tested. The first major objective was to develop practical methods and machines to eliminate the traditional high-labor-requiring practices of stacking and picking peanuts, according to the author. Integral studies, that are discussed in the paper, developed the following determinations in procedure for optimum returns in peanut production from land preparation to the marketing point: (1) in turning land it is feasible to bury raw organic litter below depth of subsequent tillage for substantial aid in the control of noxious weeds, precision operation of planting and cultivation machinery, and control of southern blight disease in peanuts; (2) obtaining good plant population stands is a major factor in man and machine power requirements for controlling noxious growth and in the attainment of high yields of top-quality peanuts; (3) removal of a portion of the vine tops preparatory to harvesting contributes to machine efficiency and the uniformity of peanut quality in harvesting by the windrow method; (4) where adequate capacity in artificial curing facilities is not provided for "green" harvesting, optimum procedure involves combine harvesting from windrows at a semi-dry stage of the peanuts. At this stage the fiber shells around the nuts are in a relatively dry state, thereby providing a wider tolerance of the nuts to time elements in artificial finish drying processes; (5) the effective depth of loose bulk peanuts in one-direction heated air drying should not exceed four feet; (6) drying air temperatures for peanuts should not exceed 100 degrees F, since consistently higher temperature may adversely affect taste developing characteristics; (7) drying air velocity is less critical than temperature intensity, and uniform velocity of 50 to 100 fpm is safe and economical; (8) damaging characteristics in shelling are associated with the lowest moisture content to which peanuts are dried at any time and, even though moisture is higher at time of shelling, the extent of damage may be greater as a result of a lower previous content of moisture; (9) no portion of a lot of peanuts should be dried, either in windrows or by artificial means, to below 7 percent moisture content (wet basis) of the nut, with hull in equilibrium, and the average moisture content of individual lots of farmer's stock peanuts should not be lower than 8½ percent. The author states that the widespread acceptance in 1958 approximately 95 percent of Georgia's 500,000 acres were harvested mechanically.

Low Profile Catching Equipment for Tree Fruit, by P. A. Adrian, R. B. Fridley, and C. R. Kaupke, respectively, agricultural engineer, ARS, USDA, and assistant specialists, Agricultural Experiment Station, University of California, Davis. Paper presented at the Winter Meeting of ASAE at Chicago, Ill., December 1959, on a program arranged by the Power and Machinery Division. Paper No. **59-601.**

This paper presents the progress on the development of an apparatus, using a new principle of fruit collection, which has been constructed and field tested. This recently developed principle of fruit collection has resulted in a significant decrease in the labor requirements for prune harvesting and in addition has a good potential on many other tree fruits, according to the paper. At this time the new catching frame is most efficient when used in conjunction with the boom type shaker. Field test results on prunes indicate a potential harvest rate of 60 trees per hour with a three-man crew. This harvest rate can be accomplished only by using bulk handling methods and by pruning the tree for mechanical harvesting.

The Effect of Heavy Applications of Nitrogen on Grasses and the Problems of Harvesting, by Burton S. Horne and William B. Gehl, respectively, associate professor of agricultural engineering extension, The Pennsylvania State University, University Park, and agricultural engineer, agricultural division, American Cyanamid Co., Princeton, N. J. Paper presented at the Winter Meeting of ASAE at Chicago, Ill., December 1959, on a program arranged by the Power and Machinery Division. Paper No. **59-602.**

The effect of heavy applications of nitrogen on grasses is a program which has been extensively studied in the past few years. Almost 100 percent of the reported data from experiment stations throughout the United States and various foreign countries recognize the favorable response of grasses to nitrogen. This paper covers the yield increases, the quality of crop, flexibility of management, fringe benefits, and moving problems. One part of the paper is devoted to the explanations of five field trials, including the procedure, conditions, a summary and analysis, and recommendations for mower design and adaptations based on the findings of the observation team. The necessity of future work and suggested avenues of approach to this mowing problem are also included, based upon the recorded experiences of these field trials.

A Continuous Flow Pasteurizer for Small Water Supplies, by Melvin Goldstein, L. J. McCabe, Jr., and Richard L. Woodward, of the Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio. Paper No. **59-230.**

A continuous flow pasteurizer which appears to be both technically and economically practical for small water treatment systems is constructed of readily available components. The pilot unit produces drinking water which meets Public Health Service bacteriological standards in sufficient quantity to supply a family of five (90,000 gal annually) at a treatment cost of $1.00 per 1,000 gal, according to the authors. This estimate is based on an electrical cost of one cent per kilowatt-hour and an annual amortization charge of 10 percent of the cost of the pasteurizer. Pasteurization is accomplished with a power consumption for pumping and heating of 38 to 40 kilowatt-hours per 1,000 gal of water treated. Most of the heat required to bring the water to pasteurization temperature is recovered through the use of a simple heat exchanger. The initial equipment cost was $520 for pasteurizer, storage tank, and auxiliary pump. The unit has produced drinking water which met PHS bacteriological standards as measured in terms of coliform organisms from influent water containing 950,000 coliforms per 100 ml. In contrast to chemical disinfection, it provides the advantages of automatic equipment and does not require an operator with technical knowledge or special skills, but the per gallon cost is higher than that for chemical treatment.

Design and Development of a Mechanical Cucumber Harvester, by G. W. Bingley, R. K. Leonard, B. A. Stout, and W. F. Buchele, respectively, jr. engineer, John Deere Harvester Works, Moline, Ill., jr. engineer, John Deere Des Moines Works, Des Moines, Iowa, assistant professor, and associate professor, agricultural engineering dept., Michigan State Univerity, East Lansing. Paper presented at the Winter Meeting of ASAE at Chicago, Ill., December 1959, on a program arranged by the Power and Machinery Division. Paper No. **59-604.**

This paper discusses the data obtained to aid in the development of a commercially acceptable mechanical cucumber harvester—namely, picking forces, specific weight, specific gravity and weight-size relationship of the cucumber fruit, and force to remove the plant from the ground. The harvester developed in this investigation, as well as other harvesters which pick from one side of the row, require trained vines. A portion of this paper is devoted to the pneumatic vine trainer which was used to accomplish the training process. The paper also reports on information obtained from several tests on the mechanical cucumber harvester performance, including power requirements and capacity of the harvester, force exerted on the vines, foliage removed, and effect of mechanical harvesting on gross return per acre.

A Farm Equipment Retailing Curriculum, by J. J. Paterson, associate professor in agricultural engineering, Southern Illinois University, School of Agriculture, Carbondale, Ill. Paper No. **59-231.**

This paper summarizes the results of a nationwide survey of 45 colleges and universities and 33 farm equipment retail associations concerning courses in farm equipment retailing. The survey indicates a general feeling that although the enrollment might not be large, the program would provide an important service to the industry. Of those surveyed, eight colleges offer a course of this nature. The length of course generally preferred was two years, but several indicated that four years would be necessary. Placement training of one or two summer terms (three to six months) was suggested.

Included in the paper is a list of courses considered necessary by 50 percent or more of those replying to the survey. Emphasis

(Continued on page 51)

Agricultural Engineering Accredited at LPI

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Graduate Fellowships in Ginning Engineering

[illegible]

Name University of Florida Agricultural Engineering Bldg

[illegible]

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LPI Agricultural Engineering Curriculum Accredited

[illegible]

Recruiting Practices and Procedures — 1959

[illegible] guide covers the general principles and the practices and procedures, which include the responsibilities of the employer, the college, and the student. Copies of the guide may be obtained from W. Leighton Collins, secretary, ASEE, University of Illinois, Urbana, at a cost of 10¢ per copy, $1.00 for 25 copies, and $3.00 per 100 copies.

Crop Dryer Manufacturers Council of FEI

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New England Farm Electrification Institute

[illegible]

Florida's Agricultural Engineering Building Named Frazier Rogers Hall

[illegible]

land vs. midwest in farm electrification will be discussed. Principals of materials handling, including equipment, controls and systems, are the topics of discussion scheduled for Thursday morning, February 4. "Youth" will be the theme of the Thursday afternoon session when A. V. Krewatch, extension agricultural engineer, University of Maryland, will talk on youth projects as I saw them in the U.S.A. The topic of youth programs of a power company also will be included in this session, plus demonstrations prepared for National Electrical Week by 4-H and FFA members. The closing session on Friday morning, February 5, will include a panel discussion on electric heating on the farm, plus discussions on how to recognize faulty operation of oil burners and controls, what's new in farm lighting, and protective controls for farm electric motors.

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The first phase of this project includes the immediate construction of greatly enlarged laboratory facilities at Birmingham, with an adjoining new building to house the offices of the research staff. These new facilities will permit the orderly and systematic transfer of the various separate research centers of the company into an enlarged centralized and integrated research and development activity.

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ASAE Members on Hall of Fame's Board of Governors

The Board of Governors of the Agriculture Hall of Fame includes four ASAE members: John T. Brown, chairman of the board, J. I. Case Co., Racine, Wis.; Harry Darby, chairman of the board, The Darby Corp., Kansas City, Kans.; Merritt D. Hill, general manager, Tractor and Implement Division, Ford Motor Co., Birmingham, Mich.; and Claude R. Wickard, former Secretary of Agriculture, Camden, Ind.

Engineering Institutes

From September 24, 1959, through January 22, 1960, Engineering Institutes have been and will be held on the Madison campus of The University of Wisconsin in the Wisconsin Center. The meetings, of two to five days presenting current information to technical personnel from industry, are for the purpose of keeping companies abreast of rapidly changing technology. Since most of the programs deal with industrial operations, speakers who are recognized authorities in their fields are obtained from manufacturing concerns. Specialists from research laboratories, consulting firms, and the faculty of The University of Wisconsin and other educational institutions are selected when the subject matter is appropriate. Material is presented by informal talks, panel discussions, films, slides, and demonstrations. No proceedings are published. Following are the Institutes yet to be held: January 18-20, Hydro-Electric Operation; January 20-22, Industrial Statistics Applications, and Technical Report Writing; and January 21-22, Industrial Power Systems.

WIN FEI AWARDS

Two ASAE members were presented the Farm Equipment Institute's Industry Merit Awards during its 66th Annual Convention in Montreal, Canada, in mid-October, 1959. • *(Left)* E. W. Tanquary, chairman, FEI advisory engineering committee, receives award for "Outstanding Engineering Contributions to Agriculture, Industry, and the Institute." He is staff engineer with the Farm Equipment Research and Engineering Center, International Harvester Co., Hinsdale, Ill., and past-president of ASAE. • *(Right)* Frank P. Hanson, chairman, FEI agricultural research committee, receives award for "Outstanding Research and Educational Contributions to Agriculture, Industry, and the Institute." He is an agricultural engineer for Caterpillar Tractor Co., Peoria, Ill. Presenting the awards is 1958-59 FEI president, George A. Kelly, II, who is president of the G. A. Kelly Plow Co., Longview, Texas

(Above) Norman A. Evans, head of agricultural engineering at Colorado State University, has been elected chairman of the Western Soil and Water Research Committee. Membership in the committee is made up of agricultural scientists from 12 western states. Two other ASAE members elected officers are R. M. Hagan and J. W. Wolfe. _Left to right:_ R. M. Hagan, head of irrigation department, University of California, Davis, three-year term on executive committee; O. J. Kelley, head of western section, Soil and Water Conservation Branch, ARS, one-year term on executive committee; Norman A. Evans; J. W. Wolfe, professor of agricultural engineering at Oregon State College, secretary; D. W. Thorne, director of the Utah State University Agricultural Experiment Station, administrative advisor to the commitee; and H. B. Cheney, head of soils department, Oregon State College, vice-chairman

(Below) J. L. Aull, state conservation engineer, (left) representing Don A. Williams, administrator, SCS, Washington, D.C., recently presented J. T. McAlister, conservation equipment engineer, SCS, USDA, and Fellow of ASAE, the USDA Certificate of Merit "for unusual service in adapting soil and water conservation practices to the use of farm equipment, and conversely, adapting farm equipment to soil and water conservation practices." The recipient has done considerable work in mulch tillage and in the layout of parallel terraces and parallel strips for more efficient use of farm equipment

Graduate Fellowships in Ginning Engineering

Fellowships worth $2,500 each are available for one year of graduate study in cotton ginning engineering at Clemson Agricultural College, Clemson, S. C. Funds are being provided by the Clayton Fund, Houston; Continental Gin Co., Birmingham; and the Murray Co. of Texas, Inc., Dallas. The grants are handled by the Foundation for Cotton Research and Education in Memphis. Preference will be given to applicants under 35 who (1) are working in some continuing phase of ginning research or education in the U.S., or to those interested in preparing for such work; and (2) hold a bachelor's degree in agricultural or mechanical engineering. All grants will be contingent upon acceptance of the candidate by the Clemson graduate school. Students successfully completing the work will receive a master's degree in agricultural engineering, with emphasis on ginning engineering. The program of instruction is receiving financial support from Centennial Cotton Gin Co., Columbus, Ga.; Harwicke-Etter Co., Sherman, Texas; Lummus Cotton Gin Co., Columbus, Ga.; John B. Mitchell Co., Dallas; and Moss-Gordin Lint Cleaner Co., Dallas. Interested candidates may obtain additional information and application forms from the National Cotton Council, Box 9905, Memphis 12, Tenn.

Name University of Florida Agricultural Engineering Bldg.

On November 21, the agricultural engineering building of the University of Florida officially became Frazier Rogers Hall. In so naming the building, the University honored the late Professor Frazier Rogers, who headed the department from 1923 until his death on July 22, 1958. He died on the eve of his retirement, which was to have become effective July 31, 1958. Professor Rogers was senior employee of the University in total years of service having joined the staff in 1918. The modern new agricultural engineering building, dedicated on October 15, 1955, had been the culmination of much effort on the part of Mr. Rogers.

Agricultural Engineering Accredited at LPI

Louisiana Polytechnic Institute's agricultural engineering curriculum has been approved by the Engineers Council for Professional Development. Shown above is the LPI agricultural engineering building.

In the ceremonies naming the building, University President J. Wayne Reitz expressed his pleasure at the fact that Professor Rogers had seen the building erected and had used it for nearly four years before his death.

LPI Agricultural Engineering Curriculum Accredited

John J. McDow, head of the agricultural department at Louisiana Polytechnic Institute, Ruston, reports that its agricultural engineering curriculum has been accredited in November by the Engineers Council for Professional Development. The professional agricultural engineering curriculum was first inaugurated at LPI in 1948 administered under the department of agriculture. In 1953, an agricultural engineering department was established and has since progressed steadily, gaining recognition by ASAE in 1958.

Recruiting Practices and Procedures — 1959

A guide for the recruiting of engineering college graduates has been published by the American Society for Engineering Education. Activities bringing together college graduates and would-be employers must meet four conditions, ASEE says: (a) To promote a wise and responsible choice of career; (b) To strengthen students' sense of integrity; (c) To develop in students an attitude of personal responsibility for their choice of career and for their success in it; and (d) To minimize interference with education. The Ethics Committee of the Engineers' Council for Professional Development, the organization responsible for accrediting engineering curricula, has endorsed the recruiting "code." An 8-page guide covers the general principles and the practices and procedures, which include the responsibilities of the employer, the college, and the student. Copies of the guide may be obtained from W. Leighton Collins, secretary, ASEE, University of Illinois, Urbana, at a cost of 10¢ per copy, $1.00 for 25 copies, and $3.00 per 100 copies.

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New England Farm Electrification Institute

The 21st annual New England Farm Electrification Institute, sponsored by the Farm Electric Service Committee of the New England Council, will be held February 3-5, 1960, at the University of Connecticut, Storrs. The tentative program will include an afternoon meeting on February 3, when the subjects of electrification programs in the United States, and New Eng-

Florida's Agricultural Engineering Building Named Frazier Rogers Hall

In a special ceremony November 21, 1959, the agricultural engineering building, University of Florida, was named in honor of the late Professor Frazier Rogers, long time department head. • *(Left)* Witnessing the unveiling of a portrait of Professor Rogers to be hung permanently in Frazier Rogers Hall is, left to right, M. A. Brooker, dean; D. T. Kinard, head of the department of agricultural engineering; W. M. Fifield, provost for agriculture; M. O. Watkins, director, Agricultural Extension Service; and H. H. Wilkowske, assistant director, Agricultural Experiment Station. • *(Right)* Same college officials present new sign for building entrance, left to right, Fifield, Brooker, Watkins, Kinard, and Wilkowske

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Two ASAE members were presented the Farm Equipment Institute's Industry Merit Awards during its 66th Annual Convention in Montreal, Canada, in mid-October, 1959. • *(Left)* E. W. Tanquary, chairman, FEI advisory engineering committee, receives award for "Outstanding Engineering Contributions to Agriculture, Industry, and the Institute." He is staff engineer with the Farm Equipment Research and Engineering Center, International Harvester Co., Hinsdale, Ill., and past-president of ASAE. • *(Right)* Frank P. Hanson, chairman, FEI agricultural research committee, receives award for "Outstanding Research and Educational Contributions to Agriculture, Industry, and the Institute." He is an agricultural engineer for Caterpillar Tractor Co., Peoria, Ill. Presenting the awards is 1958-59 FEI president, George A. Kelly, II, who is president of the G. A. Kelly Plow Co., Longview, Texas

***(Above)* Norman A. Evans, head of agricultural engineering at Colorado State University, has been elected chairman of the Western Soil and Water Research Committee. Membership in the committee is made up of agricultural scientists from 12 western states. Two other ASAE members elected officers are R. M. Hagan and J. W. Wolfe. *Left to right:* R. M. Hagan, head of irrigation department, University of California, Davis, three-year term on executive committee; O. J. Kelley, head of western section, Soil and Water Conservation Branch, ARS, one-year term on executive committee; Norman A. Evans; J. W. Wolfe, professor of agricultural engineering at Oregon State College, secretary; D. W. Thorne, director of the Utah State University Agricultural Experiment Station, administrative advisor to the commitee; and H. B. Cheney, head of soils department, Oregon State College, vice-chairman**

***(Below)* J. L. Aull, state conservation engineer, (left) representing Don A. Williams, administrator, SCS, Washington, D.C., recently presented J. T. McAlister, conservation equipment engineer, SCS, USDA, and Fellow of ASAE, the USDA Certificate of Merit "for unusual service in adapting soil and water conservation practices to the use of farm equipment, and conversely, adapting farm equipment to soil and water conservation practices." The recipient has done considerable work in mulch tillage and in the layout of parallel terraces and parallel strips for more efficient use of farm equipment**

Receiving much attention is the Aeromobile on display during the Winter Meeting of ASAE in Chicago, December 15 to 18. The ground effect type aircraft, capable of lifting 585 lb gross weight and traveling at speeds up to 40 mph, was described during the meeting by the manufacturer, W. R. Bertelsen, president of Bertelsen Mfg. Co., Inc., Neponset, Ill.

WINTER MEETING ATTENDANCE RECORD BROKEN

AGAIN, during the Winter Meeting of the American Society of Agricultural Engineers, held at the Palmer House Hotel in Chicago, December 15 to 18, previous attendance records were shattered. A total of 1533 registered surpassing last year's total by nearly 20 percent.

Council and Cabinet

The ASAE Council met Monday afternoon, all day Tuesday, and at various times to dispose of a variety of administrative matters. A summary report of Council action will appear in the February issue. The Cabinet meeting, held Tuesday evening, officially opened the three-day meeting, with introductory remarks by President L. H. Skromme. W. J. Ridout, vice-president of ASAE, introduced a suggestion that some thought be given to renaming state and local sections to chapters and forming additional sections in areas not covered by regional sections. He also urged section officers to study their respective geographic boundaries for recommendations for possible modification. Frank W. Peikert, chairman of student recruitment committee, reported that student enrollment was on a downward trend and listed several activities that could be engaged in, to bolster student enrollment.

H. S. Pringle, R. G. Morgan, J. W. Borden, and L. W. Hurlbut, members of the Motion Picture Production and Finance Committees, gave an encouraging report on the status of the ASAE motion picture project. Further details may be found on page 2 of this issue.

J. Robert Ludwig *(right)*, chief engineer, clutch division, Dana Corp., answers questions on mechanical clutch design during opening day Power and Machinery Division program. Presiding during session at left is C. B. Richey, chief research engineer, Tractor and Implement Division, Ford Motor Co. and past-chairman of Power and Machinery Division

General Session

During the general session on Thursday afternoon, December 17, L. E. Grinter, dean of the graduate school, University of Florida, spoke on "Challenges and Trends in Engineering Education." A. C. Quinn, manager, engineering test dept., Tractor and Implement Division, Ford Motor Co.; W. W. Henning, manager of engineering, Farm Equipment Group, International Harvester Co.; and D. R. Wielage, administrative assistant, John Deere Tractor Research and Engineering Center, reported on the function of the research and development center in their respective companies. The session concluded with a talk on selling engineering viewpoints to the public, by Howard Mold, director of sales personnel, Minneapolis-Honeywell Regulator Co.

A development of interest to all members occurred, following an invitation to the Council of ASAE by the Tennessee Section to hold the 1960 Winter Meeting at Memphis, Tenn. In the interest of encouraging increased attendance at the Winter Meeting from the fast-developing agricultural areas of the southern part of the United States, the Council of ASAE moved to hold the 1960 Winter Meeting in Memphis, Tenn., December 4-7 at Peabody Hotel, on a one-year trial basis with consideration for possible one-in-four-year rotation plan. The 1961 Winter Meeting will return to the Palmer House Hotel in Chicago.

(Above) A long question and answer period followed the presentation of a paper on an electrically powered tractor by Harry K. Ihrig *(left)*, vice-president in charge of research, Allis-Chalmers Mfg. Co. Shown chatting with Mr. Ihrig is E. S. Rumely, manager of product planning and programming office, Tractor and Implement Division, Ford Motor Co.

Public Relations

Again this year, the Julian J. Jackson Agency, a professional organization, was employed to handle public relations and publicity for the Winter Meeting, both on a national and local basis. A brief summary of some of the activities conducted by this group include: Prepared and distributed an advance news story announcing the meeting and 20 news release digests of papers to more than 1100 publications and broadcast media; made arrangements for 14 speakers to prepare tapes on the subject of their

(Right) Requirements for training of agricultural engineers were discussed during the Annual FEI Dinner held during the ASAE Winter Meeting. First speaker, at left, is Carl L. Hecker, chairman of the Executive Committee of the FEI, and president of the Oliver Corp., who reported on results of an extensive survey by FEI of farm machinery industry concerning requirements for training of agricultural engineers. G. A. Hawkins, dean of engineering, Purdue University, at right, discussed the engineering curriculum for today's needs

L. H. Skromme, president of ASAE and chief engineer of New Holland Machine Co., displays an official proclamation by Richard J. Daley, Mayor of the City of Chicago, declaring the week of December 14 through 18 as Agricultural Engineers Week in Chicago

The local arrangements group for the 53rd Annual Meeting of ASAE made certain that people attending the Winter Meeting would be well informed about the coming 1960 meeting to be held at Ohio State University, Columbus, June 12 to 16. M. R. Warner, extension agricultural engineer *(left)* and B. L. Bondurant *(right)*, head of agricultural engineering, both from University of Maine, examine the Ohio State display for assistance in making next summer's plans

papers for use by radio stations throughout the country; contacted Mayor Richard J. Daley for issuance of a proclamation designating December 14 to 18 as "Agricultural Engineering Week" in Chicago; made preparation for and distributed localized news stories to home town newspapers for all speakers at the meetings, plus, ASAE officers, council members, and division chairmen; arranged for television and radio shows, beginning on Sunday, December 13, throughout the week and at various times up to January 23, 1960; cooperated with radio station WLS for four tape recordings to be aired during January, 1960; and performed other necessary functions to make the above mentioned activities possible.

FEI Dinner

Representatives of the farm equipment industry and guests, consisting of agricultural engineers and research workers from state agricultural colleges and public research agencies, attended the 14th annual "dinner for professors," sponsored by the Farm Equipment Institute, Thursday evening. Carl L. Hecker, chairman of the Executive Committee of FEI and president of The Oliver Corp., reported on the results of an extensive survey by FEI of the farm machinery industry concerning its recommendations of the curriculum content most desired for the training of agricultural engineers. G. A. Hawkins, dean of engineering, Purdue University, discussed the engineering curriculum for today's needs.

Committee Activities Extensive

More than 60 committee meetings were held during early morning and late evening hours, to make this one of the most productive of any recent ASAE meeting. Most committee sessions were designated "closed" to permit committee members to devote full attention to the business at hand – that of developing standards, data, terminologies, programs, and of laying plans for the future in all technical divisions of the Society.

The success of the Winter Meeting each year is due in great part to the hard work and extra expenditure of time by the officers and their wives of the Chicago Section of ASAE. Only four were available for the camera following the announcement that an all-time high attendance record was established: *(left to right)* Tom E. Clague, Chicago Section chairman; D. P. Storm, who was in charge of publicity; J. H. Ebbinghaus, who was in charge of paper distribution; and Lee H. Ford, who assisted in paper distribution

The major "open" committee programs were those sponsored by the Research Committee and the Committee on Extension, both of which developed well-attended programs dealing with timely and pertinent topics. The Conference on the 4-H Electric Program was held in conjunction with the ASAE meeting for the first time and drew an excellent following.

(Left) The registration desk and paper distribution room were extremely busy throughout the entire meeting. A total of 1533 paid registrations were recorded establishing a Winter Meeting record. • *(Right)* The ASAE display booth attracted much attention and was staffed by ASAE personnel (left to right) Mrs. Barbara Brown, ASAE office manager; Dwight Early, Jr., advertising representative; Harmon Mulbar, public relations and advertising manager

Herman F. Bahmeier, an ASAE member since 1925 and retired head of the Grand Junction, Colo., USDI projects office, has been awarded a Distinguished Service Award by the U.S. Department of the Interior. Regarded as "dean" of the Bureau of Reclamation's construction engineers, he has followed the engineering profession since 1912. Selected from college competition for a five-year assignment in Australia, he gained valuable experience for his future career. His work included design and construction, surveying, land development economics, and instruction of individual farmers and farm organization in the art and science of farming. After 12 years with state and private interests in California, he came to the Bureau of Reclamation in August 1930 as an associate engineer in its Denver engineering office. His assignments changed gradually from agricultural engineering to construction of large irrigation and multi-purpose reclamation projects. His retirement became effective on May 29, 1959.

R. J. Alpers, sales engineer at The Michigan Vitrified Tile Co., Owosso, Mich., and **R. W. Kleis,** head of agricultural engineering, University of Massachusetts, have been named as members of the board of directors of the College of Engineering Alumni Association of Michigan State University. This is a new organization to be devoted to fostering the interests of the college and of its alumni.

O. G. Williams has accepted the position of deputy director with the National Agricultural Advisory Service in Caernarvonshire, Wales, England. He previously held the position of assistant agriculture and food attache at the British Embassy in Washington, D.C.

Stanley D. Bistline, formerly a junior test engineer with LeTourneau-Westinghouse Corp., is now associated with Boeing Airplane Co. in Wichita, Kans., as a standards engineer.

Carl W. Hall, professor in the agricultural engineering department at Michigan State University, left on January 1 for Colombia, South America, for a 3-month assignment in connection with the development of the agricultural engineering programs which have been set up with the help of MSU staff members who were previously assigned there.

W. H. Collins has joined the agricultural engineering staff of the University of Massachusetts as an instructor after completing requirements for an M.S. degree in agricultural engineering from Virginia Polytechnic Institute. He received a B.S. degree in agricultural engineering also from VPI in 1958.

Arnold A. Hayes advises he has accepted a position as sales representative for Kaiser Aluminum and Chemical Sales, Inc. and is located in Lubbock, Texas. He formerly was connected with Olin Mathieson Chemical Corp., Omaha, Nebr., as an irrigation engineer and sales supervisor.

R. J. Alpers

R. W. Kleis

P. B. Potter, life member of ASAE, retired on December 19 from active duty as a member of the agricultural engineering department staff of Virginia Polytechnic Institute. A native of Kansas, he joined the staff at VPI in 1928. He holds B.S. degrees in civil engineering and agronomy, and the agricultural engineering degree from Kansas State University. He was one of the first agricultural engineers to be professionally registered in Virginia and served with the state section committee who paved the way for agricultural engineers to become registered in this state. He was Professor C. E. Seitz's right-hand man in planning Seitz Hall, VPI agricultural engineering building, and in supervising its construction as a WPA project. He also initiated the research work in farm structures at VPI. In recent years, his major work has been the engineering responsibility of new buildings and facilities at the branch agricultural experiment stations in the state. He will continue to make his home in Blacksburg, and plans to do some part-time engineering work.

Burton Cargill has returned to the agricultural engineering department of Michigan State University after a leave of absence of 2½ years. He has been attending the University of Missouri where he obtained a Ph.D. degree.

C. J. Mackson, professor in the agricultural engineering department at Michigan State University, has been granted a National Science Fellowship for one year beginning September, 1960. This will assist him in securing a Ph.D. degree.

John F. Schrunk is now located in Portland, Ore., and is associated with Cornell Mfg. Co. as assistant manager. He formerly was chief irrigation engineer with Irrigation Equipment Co. in Denver, Colo.

Carl H. von Wolffradt now holds the position of sales engineer with the Air Products organization of Toronto, Ont., Canada. Prior to his moving to Canada, he was a project engineer with Aerovent Fan Co. of Piqua, Ohio.

John C. Woodruff, formerly with the Crouse-Hinds Co., is now associated with Alpha Portland Cement Co. of Easton, Pa., as a sales representative.

Alvah E. Worth is now senior engineer with the consulting engineering firm of J. Kenneth Fraser and Associates, East Poultney, Vt. He previously was associated with Barker and Wheeler, Engineers.

Jose M. Guzman G. has recently left the National Production Council in Desamparados, Costa Rica, Central America, and is now self-employed as a private professional engineer.

Frederic Thiele recently has sold the patent rights and consulting services of his milk equipment company, Material Handling Systems Co., Colon, Mich., to the Babson Bros. Co. (Surge) of Chicago. The sale did not include the company and Mr. Thiele will continue his work in layout and consultation for farmers needing services in mechanized farm feeding operations.

Herbert E. Butler advises that he is associated with Toxie Craft (civil engineers) in Baton Rouge, La. He was formerly employed by the Louisiana Agricultural Cooperative Inc. in Baton Rouge.

John H. Cole, with the testing department of Dunlop Tire and Rubber Corp., Buffalo, N. Y., for several years, is now located in Alliance, Ohio, with United Cooperatives, Inc., as a products engineer.

Duncan E. Holt has been transferred from the Louisville, Ky., plant of International Harvester Co. to its Lexington, Ky., plant, where he has accepted the position of assistant manager of farm equipment.

W. M. Hiddleston, who was the sales engineer of drilling equipment for Geo. E. Failing Co., Enid, Okla., now holds the position of vice-president of sales at Log-Master Services, Inc. in Enid.

James P. Locker, formerly irrigation sales engineer for Schuell Supply Corp. is now owner and manager of his own business under the name of Locker's Nitrogen and Equipment Sales in Bremen, Ind.

G. M. Rekken advises that he is now the owner of the consulting engineering firm of McDiarmaid Rekken and Associates, Edmonton, Alberta, Canada. Previously, he held the position of director of building research at Muttart Enterprises Ltd.

L. C. Wessinger, division rural sales engineer for the Georgia Power Co., has been transferred from its Augusta, Ga., office to its Rome, Ga., office.

Jack C. Williams advises that he is now associated with the American Concrete Agricultural Pipe Association, Chicago, Ill., as assistant to the managing director. He previously was an engineer with Structural Clay Products Institute.

T. W. Bohmker, who has been located in Belgium as manager of John Deere International, advises that he is now located in Mannheim, Germany, as director for Heinrich Lanz Aktiengesellscraft.

Jack D. Traywick, formerly a research instructor in the agricultural engineering department of North Carolina State College, is now in New Delhi, India, as a member of the Rockefeller Foundation agricultural field staff. He advises that one phase of the mission is a research program to help increase food, feeding and fibre production through plant breeding and improved management practices—the two main crops involved are corn and millets. The other part of the program, according to Mr. Traywick, is to assist in furthering the development of the Indian Agricultural Research Institute, which is the Central Agricultural Post-Graduate School for India.

Edward Procter, design engineer, New Holland Machine Co., New Holland, Pa., has been issued a patent on a new idler mounting for chain and belt drive machines. This device will make it easier to keep drive members tightly adjusted.

William A. Carleton has recently been promoted from district sales manager, Lansing, Mich., to division sales manager, Great Lakes Division of Armco Drainage and Metal Products, Inc. He joined the company's sales organization in 1946 and was made Michigan state sales manager in 1955.

James Greiner has been promoted from engineer trainee to junior designer in crop drying at New Holland Machine Co., New Holland, Pa.

Connecticut Valley Section

The Connecticut Valley Section will meet on February 17 at the Yankee Pedlar Inn, Holyoke, Mass. L. H. Skromme, national president, will be the featured speaker on the program following the 7:00 p.m. dinner. Mr. Skromme will speak on new farm machinery developments.

Quad City Section

The Quad City Section will hold a 6:30 p.m. dinner meeting on January 15 at the American Legion Club, Moline, Ill. During the program following the dinner, C. Jack Kennedy, partner in a 1300-acre farming operation, will report on the use of specialized equipment in a large farm operation, and Rex McCammon, grain buyer, Ralston-Purina Co. will speak on grain trading. He will also show a film produced by the Chicago Board of Trade (Grain Market) entitled "After the Harvest."

North Atlantic Section

The Annual Meeting of the North Atlantic Section will be held on August 22-24, 1960, on the campus of the University of Massachusetts. The program will be organized and conducted by: O. C. French, section chairman; R. W. Kleis, local arrangements; E. L. Arnold, electric power and processing; R. B. Furry, farm structures; B. S. Horne, power and machinery, and F. R. Hore, soil and water.

Mid-Central Section

The Mid-Central Section has scheduled a meeting for April 8 and 9 at the Hotel Robidoux in St. Joseph, Missouri.

Washington, D.C. Section

The Washington, D.C. Section held a luncheon meeting on January 8 in Room 6962, South Building, USDA, Washington, D.C. As a featured speaker, Malcolm Jones, International Cooperation Administration, gave an authoritative and first-hand description of the lives of agricultural engineers employed in the agricultural program of ICA outside of the United States.

ASAE MEETINGS CALENDAR

January 15—QUAD CITY SECTION, American Legion Club, Moline, Ill.

February 1-3 — SOUTHEAST SECTION, Birmingham, Ala.

February 12 — MICHIGAN SECTION, Detroit area. Further details later.

February 17 — CONNECTICUT VALLEY SECTION, Yankee Pedlar Inn, Holyoke, Mass.

March 4 — QUAD CITY SECTION, American Legion Club, Moline, Ill.

March 24-25 — SOUTHWEST SECTION, Washington-Youree Hotel, Shreveport, La.

April 1-2 — ROCKY MOUNTAIN SECTION, New Mexico State University, State College, N. M.

April 8-9 — MID-CENTRAL SECTION, Hotel Robidoux, St. Joseph, Mo.

April 14-15 — PACIFIC COAST SECTION, Arrowhead Conference Center of the University of California.

April 22 — QUAD CITY SECTION, American Legion Club, Moline, Ill.

June 12-16—ANNUAL MEETING, Ohio State University, Columbus, Ohio.

August 22-23—NORTH ATLANTIC SECTION, University of Massachusetts, Amherst.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Mich.

EVENTS CALENDAR

December 11 - February 14 — *New Delhi World Agriculture Fair,* New Delhi, India. Additional information may be obtained by writing to Farm Equipment Institute, 608 S. Dearborn St., Chicago 5, Illinois

January 20 — *Farm Equipment Institute* Winter Meeting, Hotel Peabody, Memphis, Tenn. Contact FEI, 608 S. Dearborn St., Chicago 5, Ill., for details.

January 21-22—13th Annual *Southern Farm Forum,* Roosevelt Hotel, New Orleans, La., sponsored by the Agricultural Committee of the Chamber of Commerce of the New Orleans area. For details write to SFF, P.O. Box 1460, New Orleans, La.

January 25-28 — *Plant Maintenance and Engineering Show,* Convention Hall, Philadelphia, Pa. Clapp & Poliak, Inc., 341 Madison Ave., New York, N. Y., will furnish additional information.

January 25-29 — *Stress Measurement Symposium,* Arizona State University, Tempe, Ariz., sponsored by Strain Gage Readings. Further details may be obtained by writing to Peter K. Stein, Editor, Strain Gage Readings, 5602 E. Monte Rosa, Phoenix, Ariz.

January 27-28—12th Annual *College-Industry Conference,* of the *American Society for Engineering Education,* Washington University, St. Louis, Mo. Further information may be obtained by writing to Don A. Fischer, dean, school of engineering, Washington University, St. Louis 30, Mo.

February 1-3 — *Association of Southern Agricultural Workers,* 57th Annual Meeting, Dinkler-Tutwiler Hotel, Birmingham, Ala. For information write to C. E. Kemmerly, Jr., Secretary-Treasurer, Louisiana State University, Baton Rouge, La.

February 1-4—*American Society of Heating, Refrigerating and Air-Conditioning Engineers,* Semiannual Meeting, and the *Second Southwest Heating and Air-Conditioning Exposition,* Memorial Auditorium, Dallas, Texas. To obtain details contact ASHRA headquarters, 62 Worth St., New York 13, N. Y.

February 1-5 — *Farmers' Week* at Michigan State University, East Lansing, Mich. Details may be obtained from the Department of Information Services, MSU, East Lansing, Mich.

February 3-5 — 21st Annual *New England Farm Electrification Institute,* University of Connecticut, Storrs. Write to Agricultural Engineering Dept., University of Connecticut, Storrs, Conn., for additional information.

February 15 - 19 — 35th *Norelco X-Ray School,* Henry Hudson Hotel, 353 W. 57th St., New York, N. Y. For complete details contact Philips Electronic Instruments, 750 Fulton Ave., Mount Vernon, New York

February 18-20 — Winter Meeting of the *National Society of Professional Engineers,* Broadview Hotel, Wichita, Kans. For further information write to the Society headquarters, 2029 K St., N.W., Washington 6, D.C.

March 1-6 — *31st Salon International De La Machine Agricole (Agricultural Machinery Show),* Paris, France. Additional information will be furnished by the Commercial Counselor, French Embassy, 610 Fifth Ave., New York 20, N. Y.

April 3-8 — *1960 Nuclear Congress* with *1960 Atomic Exposition,* New York Coliseum, New York City. Additional information may be obtained from Engineers Joint Council, 29 W. 39th St., New York 18, N. Y.

April 18-20 — *Seventh National Watershed Congress,* Washington, D.C. Write to The National Association of Soil Conservation Districts, Service Dept., League City, Texas, for further details.

April 25-29 — *American Welding Society's* 41st Annual Convention and Welding Exposition. Convention will be held in the Biltmore Hotel, and the Welding Exposition in the Great Western Exhibit Center, Los Angeles, Calif. For further details write Information Center, AWS, 33 W. 39th St., New York 18, N. Y.

May 23-26 — *Design Engineering Show,* New York Coliseum, New York City. For information write to Clapp & Poliak, Inc., 341 Madison Ave., New York 17, New York

October 19, 1960 - September 14, 1961—4th *International Course in Hydraulic Engineering,* Delft, the Netherlands. Further particulars may be obtained from the Netherlands Universities Foundation for International Cooperation, 27 Molenstraat, The Hague, Netherlands.

October 31 - November 5 — 22nd *Dairy Industries Exposition,* International Amphitheatre, Chicago, Ill., under the sponsorship of Dairy Industries Supply Assn. Eight other dairy industry organizations will hold meetings concurrently. Additional information may be had by writing to Dairy Industries Supply Assn., Room 512, 1145 19th St., N.W., Washington 6, D.C.

... Technical Paper Abstracts

(Continued from page 43)

placed on various fields of study by both colleges and retail associations also is indicated in the paper. Farm equipment associations stressed business courses over those in agriculture, excepting agricultural economics, while colleges placed similar emphasis on both. Conservation rated high in all replies, and courses in speech, both written and oral communications, and related subjects were placed at the top of the list of necessary courses by a large majority of those surveyed. The material in the paper should be useful to those offering or planning to offer courses for students interested in farm equipment sales and service at the retail or wholesale level.

The Logarithmic Sprayer for Chemical Screening Plots, by W. E. Yates and F. M. Ashton, respectively, assistant professor of agricultural engineering and assistant professor of botany, University of California, Davis. Paper presented at the Winter Meeting of ASAE at Chicago, Ill., December 1959, on a program arranged by the Power and Machinery Division. Paper No. **59-605.**

Research scientists in agricultural chemical industries, governmental agencies, universities and extension services each year are evaluating the biological effects of thousands of agricultural chemicals. This paper discusses the general design criteria, critical components, construction, calibration and operation of a simple, complete, lightweight "logarithmic" dosage sprayer which the chemical concentration decreases logarithmically with distance traveled. The theoretical relationships of concentration, flow rate, spray time, distance traveled, speed, "half-life" and "half-distance" are derived. Experimental values were obtained which closely followed the theoretical relationships. Typical field results are also discussed.

Herbicide Application on Sweet Potatoes, by Wiley D. Poole, Travis Hernandez, and Teme Hernandez, respectively, professor, agricultural engineering dept., and associate professor and professor, horticulture dept., Louisiana State University, Baton Rouge. Paper presented at the Winter Meeting of ASAE at Chicago, Ill., December 1959, on a program arranged by the Power and Machinery Division. Paper No. **59-606.**

Farmers are finding it increasingly difficult to obtain labor for hoeing grass and weeds from early planted sweet potatoes and such labor cost is increasing. It was with the thought of eliminating entirely the operation of hoeing that experiments using herbicides for grass and weed control were conducted. This paper tells of the early experiments on pre-planting sprays and of later experiments of post-planting application of herbicides. It also lists information obtained on tests made with granular and liquid herbicides.

The Effect of Chemical Weed Spray on Alfalfa Root Decay and Subsequent Draft Requirements for Plowing, by Donald D. Hamann and Gerald C. Zoerb, respectively instructor and associate professor, agricultural engineering dept., South Dakota State College, Brookings. Paper presented at the Winter Meeting of ASAE at Chicago, Ill., December 1959, on a program arranged by the Power and Machinery Division. Paper No. **59-607.**

This paper discusses the research done to determine if there was any subsequent reduction in draft derived from spraying alfalfa before plowing. The first part of the paper deals with the equipment used in the study with emphasis on the purpose of each piece of equipment rather than how it is constructed. The split plot layout and procedure in the field is then discussed followed by results of the tests. These test data are shown in table form and significant points emphasized. A portion of the paper also deals with equipment used, procedure, and results of tests conducted in the laboratory to determine what effect, if any, the chemical application had on the root strength.

Engineering Safe Ammonia Equipment, by Mansel M. Mayeux, associate professor, agricultural engineering dept., Louisiana State University, Baton Rouge. Paper presented at the Winter Meeting of ASAE at Chicago, Ill., December 1959, on a program arranged by the Power and Machinery Division. Paper No. **59-609.**

The scope of this paper is limited to the engineering work conducted at Louisiana State University and aimed at providing safe ammonia equipment. It discusses the problem of stress corrosion cracking of ammonia vessels and shows how stress relieving of vessels has minimized that problem. It points out the problems experienced with relief valves and outlines how a uniform flow rating system has helped improve the quality of valves. It summarizes the principles of excess flow valves and suggests a manner of flow rating them. It discusses the hose test conducted at LSU and points out materials and techniques found to be satisfactory for the construction of hose.

Reducing Tractor Costs by the Use of Optimum Speeds, by S. G. Huber and B. J. Lamp, associate professors, agricultural engineering dept., Ohio State University, Columbus. Paper presented at the Winter Meeting of ASAE at Chicago, Ill., December 1959, on a program arranged by the Power and Machinery Division. Paper No. **59-610.**

The results of tests conducted with five gasoline and three diesel tractors, to determine the effect of varying engine speed and load upon brake thermal efficiency, are discussed in this paper. It was found that at light loads maximum brake thermal efficiencies were obtained at reduced engine speeds. At 30 percent of maximum horsepower, reduced engine speeds resulted in brake thermal efficiencies up to 66 percent greater than efficiencies at wide open setting of the hand throttle. The improvement in thermal efficiency obtained by reducing the engine speeds on light loads was attributed primarily to the reduction in frictional horsepower loss. From the tractors studied it was concluded that: Brake thermal efficiencies of tractor engines decrease rapidly as the load is reduced at the wide open hand throttle position; nearly maximum brake thermal efficiencies may be obtained down to 50 percent of maximum horsepower by selecting the proper engine speed; small gasoline engines will show a greater percentage savings in fuel by selecting the proper engine speed than will large engines.

Value of Differential Locks on Farm Tractors, by G. Lynne Geiger, research engineer, Tractor and Implement Division, Ford Motor Co., Birmingham, Mich. Paper presented at the Winter Meeting of ASAE at Chicago, Ill., December 1959, on a program arranged by the Power and Machinery Division. Paper No. **59-611.**

This paper reports on the investigation made of the effect of a differential lock and various amounts of wheel weights on slippage and slippage difference between the drive wheel when plowing under various conditions. Reference is made to differences in farming conditions in the United States and in Europe where differential locks on tractors are popular. Distinction is made between differential lock applications on tractors and automotive vehicles. Field operational observations are related to theoretical analysis of tractive effort when differentials are locked, conventional, or conventional with one wheel braked. Tractor drive wheel slippage data were obtained with two and three-bottom plows in moist, intermediate, and dry soils and dry and wet cover. Actual farmer-owned tractors were investigated. Slippage and slippage difference were plotted against wheel weight and weight difference.

Adapting Building Designs to Technological Changes in Hog and Poultry Production, by J. Dewey Long, consulting agricultural engineer, Stran-Steel Corp., Detroit, Mich. Paper presented at the Winter Meeting of ASAE at Chicago, Ill., December 1959, on a program arranged by the Farm Structures Division. Paper No. **59-800.**

This paper tells of today's trend to large-scale, mechanized, confined and concentrated production in hog and poultry enterprises. With its housing investment becoming an investment of major proportion and a major factor contributing to profits, according to the paper, the agricultural engineer must assume a major responsibility in refining the housing requirements. Included in the functional design specifications listed in the paper are the special requirements for fully-enclosed and windowless housing, recommendations on population densities; and specifications on thermal insulation, moisture vapor barriers, ventilation, humidity and temperature ranges, lighting and air-conditioning. Current practice or desirable standards for each are also given. The labor-saving aspect of mechanized housing is stressed as probably the most important reason for farmer interest in this trend, and the various items included in the mechanized design are listed. Suggestions are also listed for the functional requirements of a ventilation system, which has operated satisfactorily. Attention is directed to the desirability of encouraging farmers to secure competent engineering assistance when undertaking the investment required for an enterprise of this type.

Light-Intensity Control Chamber, by H. B. Puckett, D. R. Daum, F. W. Andrew, and A. V. Nalbandov, respectively, agricultural engineer, Farm Electrification Research Branch, AERD, USDA, instructor and associate professor, agricultural engineering, and professor of animal physiology, University of Illinois. Paper presented at the Winter Meeting of ASAE at Chicago, Ill., December 1959, on a program arranged by the Electric Power and Processing Division. Paper No. **59-903.**

Photoperiodic effects on plants have been established. However, the effects of varying light and dark periods on domestic animals are not so well documented as those on plants and fowls. Therefore, a study of photoperiodism in farm animals was considered desirable. The light-intensity control chamber, described in this paper, was designed and constructed to study phototonus in rats and other laboratory animals. It deals with the requirements for designing and building a light-intensity control chamber; the required controls, light source, and ventilation. Nine series of tests involving 90 animals have been completed.

Air Cleaner Filters

Purolator Products, Inc., Rahway, N. J., announces a new line of small filters for multipurpose air cleaner-breather applications. They are specially designed of dry-type air filters for use on hydraulic breathers and all types of small air-cooled engines and

air compressors. Measuring approximately 3 x 4¾ in., this new filter consists of a replaceable resin-impregnated paper element, preformed and accordion-pleated to provide greater filtering area. It reportedly handles flows up to 15 cu ft of air per minute and to remove contaminants as small as 10 microns from the air stream.

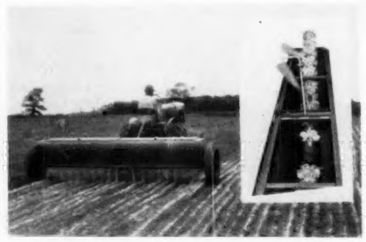
Hopper Feeders

New Holland Machine Co., New Holland, Pa., announces that two hopper feeders with flared troughs and wide-throated discharges to accommodate all sizes of hay bales are being added to its materials-handling equipment line. One is a self-powered feeder and the second is intended for attachment to the company's elevators. High-speed flights and a bangboard permit fast unloading of grain from any truck or box without spillage. Standard equipment for the model for attachment to elevators in-

cludes a 6-ft table, adjustable counter-balanced springs for easy lifting, complete drive parts and the necessary parts to attach the hopper feeder to the company's elevator. Standard equipment on the self-powered model includes a 6-ft table, 27 to 31-in. adjustable discharge height, wheels, axle, motor mount, motor pulley, drive belt and bangboard. Overall length of both models is 8 ft. Basic parts of both units are standardized, making it possible to convert from attached type to self-powered.

Improves Spreader Features

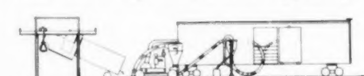
New Idea Farm Equipment Co., Coldwater, Ohio, has announced availability of quickly removable agitators, quick change shutters and easily replaceable bottoms on new 8, 10, and 12-ft fertilizer and lime spreaders. Bearing locking rods are designed to permit removal of the cam agi-



tators in minutes, making it easy to clean out the machine after each use. Changing shutters is said to be a 60-second job, and if necessary, the entire bottom of the spreader can be removed. Optional equipment includes a seeder attachment that mounts quickly on the front of the spreader box in full view of the tractor operator, and is controlled from the tractor seat.

New Grain Handling System

Dunbar-Kapple, Inc., Batavia, Ill., has developed a new grain handling system designed for fast unloading of trucks and loading into boxcars, trailer trucks, buildings and bins. The unit consists of four basic parts—a truck lift, an all-steel hopper type sink, a standard Vac-U-Vator, and a mobile grain cleaner. A foreign material receptacle and the necessary fixed or flexible ductwork round out the complete system. The system is designed to be erected quickly and dismantled easily. The sink is partially sunk into the ground, and is topped by a



grated drive-over bridge. Grain-carrying trucks drive across the grating and stop at the truck lift. Here slings are attached to the front wheels of the truck and the front end of the truck is hoisted, allowing the grain to flow out of the truck bed directly into the sink. Grain falls through the grating into an opening in the bottom of the sink. The Vac-U-Vator then sucks the grain out of the sink through a high-speed connection. The grain is conveyed into a boxcar, warehouse, storage bin, or any type of container. All movement of grain is done by air.

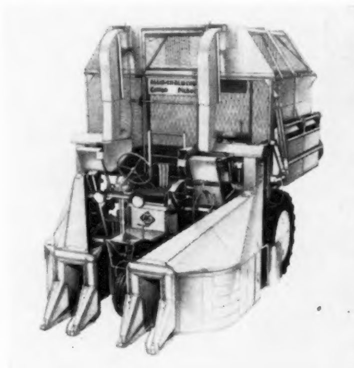
Steep-Roof Grain Bin

Behlen Mfg. Co., Columbus, Nebr., announces a new grain bin design which incorporates a steep-pitch roof and an eave-seal design which provides for continuous connection between the roof and sidewall. Sizes of this bin range from 950 to 15,000-bu capacity. The manufacturer claims that

grain can be filled to the top of the steep-pitch roof since the steep-roof angle (steeper than the angle of repose of free-flowing grain) allows the grain to fill naturally to the top of the roof. . . . The eave-seal design, a continuous connection between roof and sidewall, it is claimed, provides a wider eave seal against weather than conventional bins.

New S-P Cotton Picker

Allis-Chalmers Manufacturing Co., Tractor Group, Milwaukee, Wis., has introduced a new 2-row Model 500 self-propelled cotton picker available with two different types of spindles. One, the self-sharpening Tupelo spindle, is chrome-plated and has recessed barbs. The barb points are flush with the circumference of the spindle which, it is said, assures cleaner picking with a minimum of moistening and helps to maintain staple length for better grades. The new model is also available with fluted or knurled-type spindles. These are cadmium-plated for weather and rust resistance. A



new rotating, rubber-edged beater unit assures fast delivery of cotton from the stripper to the elevator with trouble-free operation and less danger of plugging. A new hydraulically operated basket with adequate clearance for unloading has a capacity of about 1,300 lb of seed cotton. Engine power operates a heavy-duty chain raddle unit for automatic unloading. The unit is available with either gasoline or diesel power. Between cotton harvests, the tractor can be removed from the picker and, with the addition of a conversion unit, can be used for other field work. A new one-row unit is also available for mounting on A-C D-17, D-14, WD-45, WD and CA tractors.

(Continued on page 54)

MANUFACTURERS' LITERATURE

Literature listed below may be obtained by writing the manufacturer.

Tractors and Related Equipment

Allis-Chalmers Mfg. Co., Farm Equip-Div., Milwaukee 1, Wis. – A 24-page catalog (TL-2026) illustrating A-C D-14 and D-17 tractors at work with the company's extensive line of implements designed and built to match the work capabilities of these tractors. It also gives a pictorial review of important technical aspects of this equipment and includes specifications.

Hydrostatic Torque Meter

Frederick Products Co., P.O. Box 4827, Detroit 19, Mich. – Technical Bulletin No. 21 describes and illustrates the Buchele hydrostatic torque meter, model TM-36-70-1. Operation, features, including optional features, and ratings are given in this bulletin.

Ribbon Filter Elements

Bendix Filter Division of Bendix Aviation Corp., 434 W. 12-Mile Road, Madison Heights, Mich.–A 4-page, 2-color brochure (No. BFD-44) describes the Series 2200 microbon ribbon fluid filter elements. It is illustrated with photographs, drawings, curves, and tables, and the application of microbon elements in various liquids and gases, including hydraulic oil, gasoline, air, lubricating oil, water, kerosene, and fuel oil are discussed. The filtration principles and cleaning techniques are described and representative flow rate data is presented in a series of graphs. Standard sizes and tolerances available in microbon are also listed.

Hydraulic Cylinders

Prince Manufacturing Corp., Fourth and Water Streets, Sioux City, Iowa–A 25-page catalog which completely describes and illustrates over 80 different cylinder models. Also included is a section devoted to breathers, gages, pumps, valves, etc.

Electric Plants

Kohler Co., Kohler, Wis. – A 12-page folder (E 344) illustrating the complete line of standard electric plants is now available. Electric plants for stand-by or sole supply ranging in size from 500 watts to 100,000 watts are described.

Testing Equipment

Soiltest, Inc., 4711 W. North Ave., Chicago 39, Ill. – Just published is the 316-page, 1960 Engineering Testing Equipment catalog. Included in the catalog are descriptions of over 3400 different items ranging from a small pocket-sized soil penetrometer to completely equipped mobile laboratories, nuclear moisture and density testing equipment, laboratory ovens, scales, and load indicators.

Electrode Pocket Guide

Air Reduction Sales Co., Div. of Air Reduction Co., Inc., 150 E. 42nd St., New York 17, N. Y. – 64-Page booklet (Form ADC 650) contains a brief description, together with applications, procedures and pertinent AWS-ASTM data, for all types of available electrodes (mild steel, low alloy, low hydrogen, iron powder, stainless steel, hardfacing, nonferrous, and cast iron). Also included are two 8-page foldout charts of recommended electrodes for welding ASTM and trade name steels, and comparison tables for mild steel and hardfacing electrodes of leading manufacturers.

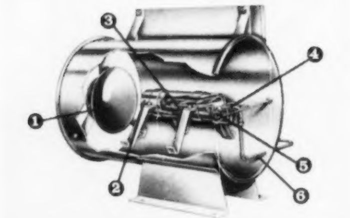
(Continued on page 56)

. . . New Products

(Continued from page 52)

Warm Air Heater Crop Conditioner

Chicago Blower Corp., Farm Products Div., 9867 Pacific Ave., Franklin Park, Ill., has introduced a new crop conditioner de-

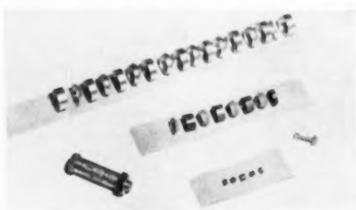


signed to aerate and dry grain during storage. Combined with a vane axial crop drying fan the warm air heater forms an all-in-one assembly without ductwork. Basically, the unit consists of a sheet metal round duct with the heating element mounted in the middle of the cylinder Heat is supplied by propane, butane, or a combination of the two. Initial ignition is supplied by an electrode, and the flame is continuous thereafter.

Normal operating voltage is 110 volts a-c. The unit may be modified for operation at 6 or 12-volts d-c, or 230 volts a-c. Fan sizes are offered in 18 and 22 in. sizes, ranging from $1\frac{1}{2}$ to $7\frac{1}{2}$ hp. Heaters are available from 400,500 to 920.000 Btu. Cutaway shows internal construction of heater unit: (1) flame target; (2) combustion barrel; (3) mixing tube; (4) nozzle; (5) ignition electrode; and (6) fuel supply line.

Adjustable Bushings

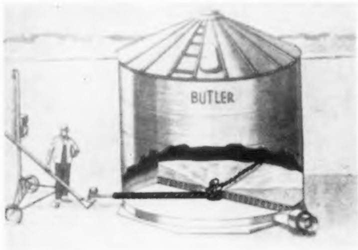
Globe Bushing Corp., 12036 Vose St., North Hollywood, Calif., announces development of a new, adjustable wall thickness



bushing which it is said permits radial dimensions to be easily and exactly varied by a simple mechanical adjustment. The bushing consists of a series of alternate male and female segments aligned axially, the application of an axial compressive force to the ends of the bushing causing the male segments to assume a smaller diameter, thus reducing the inside diameter of the bushing. At the same time the female segments assume a larger diameter thus increasing the outside diameter of the bushing. All segments are slit axially through one wall to provide ease of adjustment. This simultaneous decrease in inside diameter and increase in outside diameter is said to result in a thicker wall for the bushing.

Automatic Bin Unloader

Butler Mfg. Co., 7400 E. 13th, Kansas City 26, Mo., announces a new automatic unloader which it is claimed will quickly



empty round, metal grain bins completely without shoveling or working inside the bins. It consists of a flexible sweep auger with dustproof electric motor that operates inside the bin and a subfloor auger that inserts in a 7-in. tube under the bin floor. The subfloor auger draws all flowable grain out of the bin through an opening in the center of the floor. Then the flexible sweep auger takes over and pulls the remaining grain to the center floor hopper and out of the bin. It can be installed in 14, 18 and 21-ft diameter bins. Subfloor auger tubes in center-of-floor hopper are installed permanently in each bin.

New Loader and Backhoe

International Harvester Co., 180 N. Michigan Ave., Chicago, Ill., announces a new loader and backhoe combination built for

sustained heavy-duty loading and trenching operations. It has a rated capacity of 3500 lb at full lift and features an automatic hydraulic self-leveling action which enables the bucket to return from full dump height to a preset digging angle, using boom control only. Its 64-in. wide bucket has a capacity of $\frac{5}{8}$ cu yd struck to $\frac{7}{8}$ cu yd fully heaped. Its construction includes a unit-welded tubular frame anchored to the axles for proper distribution of loads and stresses, two steel trunnions to tie the lift arms together to eliminate racking and distortion, and a step-in design for free access to the seat. It digs and maintains trench grades up to a depth of 10 ft, and is said to dig efficiently at right angles to the tractor with a full 180-deg arc of swing. Individually adjustable stabilizers provide leveling on grades on rough ground.

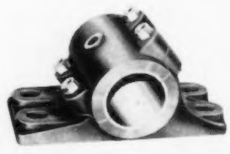
Adds to Bearing Block Line

Link-Belt Co., Prudential Plaza, Chicago 1, Ill., has announced the addition of 45 new sizes, in five new series, to its line of babbitted and bronze bearing blocks. With the new additions, the company now offers off-the-shelf delivery on more than 15 types and over 300 sizes of solid, split, gibbed, angle or flanged pillow blocks for commercial shafting up to 12 in. in diameter. The new sizes added to the line include:

(A) Series 1000-Z pillow blocks (14 new sizes), solid gray iron housing with bronze bearings. These pillow blocks have two-bolt bases and are used for general applications where cap removal is not required.

(B) Series 2-1400 babbitted and 2K-1400Z bronze bearing pillow blocks (16 new sizes). Series 2-1400 pillow blocks have split, gray iron housings with babbitted bearings. Series 2K-1400Z pillow

A



B

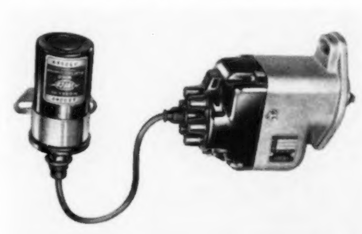
C

blocks have split, cast steel housings with bronze bearings. Both blocks have four-bolt bases and machine finished gibbed joints.

(C) Series 2-1500 babbitted bearing and 2-1500Z bronze bearing pillow blocks (15 new sizes). Series 2-1500 pillow blocks have split, gray iron housings with babbitted bearings. Series 2-1500Z pillow blocks also have split, gray iron housings with bronze bearings. Both these pillow blocks have four-bolt bases and 40-deg angular joints.

Hi-Lo Tension Magneto

Wico Electric Co., W. Springfield, Mass., announces a new magneto that is adapted for use on most gasoline and dry-fuel-



burning 6-cylinder engines. It is claimed to combine the advantages of both systems — high voltage and low tension — but requiring only one coil per engine. Electrical failure from ozone and high-voltage breakdown is said to be practically eliminated due to the heavy-duty transformer coil being encased in an oil-filled metal jacket. The manufacturer claims that this system has more output, is more powerful than the standard type, and is low in maintenance. It is available with either base or flange mounting. *(Continued on page 56)*

NOW–

Series E Bonds

turn $18.75 into $25.00 fourteen months quicker than ever before

YOUR MONEY GROWS 33⅓% IN JUST 7 YEARS AND 9 MONTHS WITH NEW SERIES E BONDS

Here are three new reasons why today's Savings Bonds are the best ones in history:

1. ***Every Bond bought since June 1, 1959, earns 3¾% interest when held the full term. Series E Bonds now mature in 7 years, 9 months—fourteen months faster than ever before.***
2. ***Your older Bonds now earn more—an extra ½% from June 1 on, until maturity.***
3. ***All Series E Bonds, old and new, carry an automatic extension privilege now. This means they'll automatically keep earning liberal interest for 10 years beyond maturity.***

You get these new advantages, plus complete safety, guaranteed return, and protection against loss or theft when you save with Bonds. And there's no easier way to save. You can buy Bonds automatically through the Payroll Savings Plan at work, or from any bank. Plan to start saving with U.S. Savings Bonds—they're the *best ever*.

YOU SAVE MORE THAN MONEY

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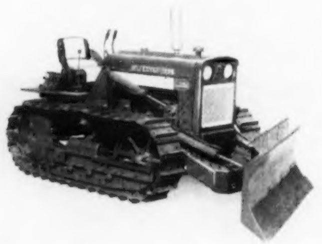
AGRICULTURAL ENGINEERING

. . . New Products

(Continued from page 54)

Hydraulic Bullgrader

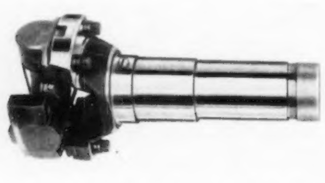
International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill., has introduced a hydraulic bullgrader, $85\frac{1}{4}$ in. wide and



heavily reinforced for high-capacity earthmoving for use with the International T-340 crawler tractor. Only two control levers are needed to deliver a wide range of angle, tilt and height adjustments. The blade can be set to a depth of $11\frac{3}{4}$ in. below grade and raised to a height of 35 in. above grade. Angling positions vary from 25 deg right to 25 deg left. Either end of the blade can be raised or lowered as much as 15 in.

New Universal Joint

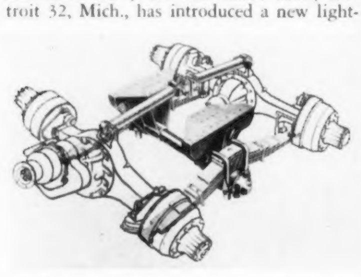
Rockwell-Standard Corp., Universal Joint Division, Allegan, Mich., has introduced a new Blood Brothers universal joint, de-



signed to provide 39,000 in.-lb of torque with a swing diameter of only 6 in. Another important feature of this unit is a key type yoke for ease of assembly and maintenance. The new universal joint is designed for drive line applications on medium trucks and off-highway equipment, and also for special applications such as small crawlers and front end loaders of $1\frac{1}{2}$-yard capacity. It can be made up as a complete drive line or as a component for assembly in close coupled drives.

New Tandem Suspension

Rockwell-Standard Corp., Transmission and Axle Div., 100-400 Clark Ave., Detroit 32, Mich., has introduced a new light-



weight tandem suspension unit for trucks and tractors. The new unit is available in two versions — all-steel, or equipped with aluminum frame support brackets and torque rods. Design features claimed are minimum maintenance, easy removal of either axle and ability to maintain load stability.

2-3 Plow Diesel Tractor

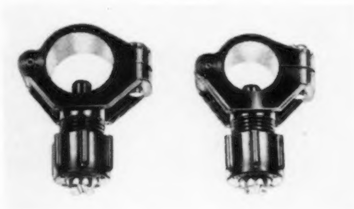
International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill., has announced that its International B-275 diesel-powered

farm tractor, in the 2-3 plow class, is being marketed nationally. The low-profile model was introduced to the southeastern part of the United States in May. The company says that it is now making the tractor available in other parts of the country because of adaptability to both large and small acreage farms, as well as for industrial use.

The tractor weighs 3465 lb and is powered by a 4-cylinder diesel engine with 144 cu-in. displacement, said to develop 32 belt and 29 drawbar horsepower.

Nylon Eyelets for Sprayers

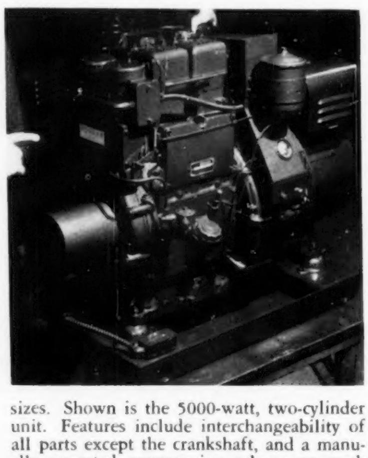
Delavan Manufacturing Co., 811 Fourth St., West Des Moines, Iowa, has developed nylon eyelets for farm sprayers. The new



nylon eyelets are specifically manufactured with the properties and characteristics of nylon in mind. They are simple to install on the boom, have only one cap screw to tighten. Installation in production can be done by drilling or punching an $\frac{11}{32}$-in. hole in the boom. A lock nut is available for clamping to angle or channel boom. Shown are both $\frac{3}{4}$ and $\frac{1}{2}$-in. sizes.

Three New Electric Plants

Kohler Co., Kohler, Wis., has announced three new air-cooled diesel electric plants, available in 2000, 5000, and 7500 watt



sizes. Shown is the 5000-watt, two-cylinder unit. Features include interchangeability of all parts except the crankshaft, and a manually operated compression release on push button and manual starting models with a solenoid operated compression release on the remote starting models.

. . . Manufacturers' Literature

(Continued from page 53)

Heavy Duty Roller Bearings

The Torrington Co., Torrington, Conn.—Catalog 359 describes the new HJ series roller bearings, featuring a patented one-piece cage design, including design, load capacity, installation, and lubrication.

Grain Storage Handbook

Behlen Manufacturing Co., Columbus, Nebr. — This 32-page reference handbook of ASC and CCC regulations on farm grain storage is entitled "You . . . and On-The-Farm Grain Storage" and answers such questions as: Who is eligible for a government loan?; how do you go about getting the loan?; how do you pay back the loan?; ASC approved equipment, etc.

Bearing Blocks and Takeups

Link-Belt Company, Dept. PR, Prudential Plaza, Chicago 1, Ill. — Full information on complete line of babbitted, bronze, and plain bore bearing blocks and takeups is given in 16-page book (2707). With the addition to the line of 119 new sizes, in eight series, this brochure describes more than 15 types and over 300 sizes of solid, split, gibbed, angle or flanged pillow blocks for commercial shafting up to 12 in. in diameter, and over 200 different sizes of takeups.

Control Catalog

General Electric Co., Schenectady 5, N. Y. — Illustrated publication GEC-1260D contains 72 pages of information on complete line of control devices, including product description of motor starters (manual and magnetic), contactors, relays, solenoids, limit switches, push buttons, static control and pilot devices. Pricing tables, features, wiring diagrams, dimensions, and application information for each device are also given. Horsepower selection charts are listed for motors from one-fourth through 200 hp, as well as a handbook section and available supplemental bulletins for each product type.

Pillow Block Bearing Catalog

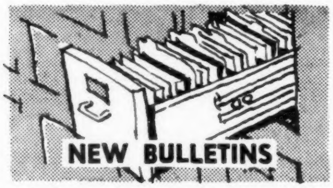
Triangle Manufacturing Co., Oshkosh, Wis.—Detailed information on pillow block bearings and mountings, their applications, variations, lubrication and installation, is contained in 40-page catalog No. 51-59. Described and illustrated is line of sleeve-type, self-aligning pillow blocks — including single-bolt mountings, wall bearings, pedestal bearings, tri-arm bracket assemblies, plain and cushioned flange mountings.

Insulated Building Panels

Aluminum Company of America, 1501 Alcoa Building, Pittsburgh 19, Pa. — "This Is Alply," a 24-page technical brochure, describes and illustrates insulated building panels — including design information, densities, U values, strengths, tolerances, manufacturing standards, and available finishes.

Inflatable Void Forms

Elgood Concrete Forms Corp., 378 Ten Eyck St., Brooklyn 6, N. Y. — 12-Page Catalog No. 601 describes and illustrates reusable inflatable void forms for: Prestressed and precast products (cored roof, floor and wall slabs, hollow piles, cored columns and piers, cored beams); cast in place (cored roof and floor slabs, canopy and lift slabs, service ducts, bridge decks, columns, piers); drains (surface, slotted, porous, vertical and horizontal); monolithic sewers (round, egg-shaped); monolithic pressure pipe (siphons, irrigation channels and feeders, water mains).



The following bulletins have been released recently. Copies may be obtained by writing to author or institution listed with each.

Make Your Water Supply Safe, by N. H. Wooding, Jr. Special Circular 45. Extension Service, College of Agriculture, The Pennsylvania State University, University Park, Pa.

Pump and Motor Testing-Rating Standards. Effective July 1, 1959. National Association, Domestic and Farm Pump Manufacturers, 1028 Connecticut Ave., N. W., Washington 6, D. C.

Tractor Upsets, by Sigfrid Bjerninger. Bulletin 279. Summary in English. Swedish Institute of Agricultural Engineering, Ultuna, Uppsala 7, Sweden.

A Selected List of Career Guidance Publications. Booklet, 1959. American Association for the Advancement of Science, 1515 Massachusetts Ave., N.W., Washington 5, D. C.

Forced Air Fruit Cooler (Plan No. 5860), Self-Feeder for Sheep—Type 'A' (Plan No. 5861), Covered Feeder for Cattle—Type 'B' (Plan No. 5862), and *Combmination Lamb Brooder and Ewe Feeder (Plan No. 5863).* USDA Miscellaneous Publications 805, 803, 802 and 804, respectively. October 1959. Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. Price, 5 cents each.

1959 Potato Handbook — "Potato Varieties." The Potato Association of America, 4121 Mineral Point Road, Madison, Wis. Price, $2.00.

Methods and Equipment for Ice-Packing Poultry, by Rex E. Childs and P. D. Rodgers. Marketing Research Report No. 242. University of Georgia, College of Agriculture Experiment Stations, Athens, Ga.

Washington Farm Electrification Committee 1958 Progress Report. May 1959. State College of Washington, Pullman, Wash.

Bibliography on Methods for Determining Soil Moisture, by Mark D. Shaw and William C. Arble. Engineering Research Bulletin B-78. June 1959. College of Engineering and Architecture, The Pennsylvania State University, University Park, Pa. Price, $2.00.

Characteristics of an Aircraft Distributor for Granular Materials, by W. G. Lovely and F. M. Cunningham (Bulletin ARS-42-25). May 1959. *A Lister Planter Attachment for Side-Band Placement of Starter Fertilizer,* by R. J. Rowe and W. G. Lovely (Bulletin ARS-42-26). May 1959. *Electrostatic Precipitation of Pesticidal Dusts, an Outline of Research and Literature,* by Ross D. Brazee and Wesley F. Buchele (Bulletin ARS-42-29). July 1959. *Estimating Cooling Loads for Air-Conditioning Swine Housing,* by LeRoy Hahn, T. E. Bond, C. F. Kelly, and Hubert Heitman, Jr. (Bulletin ARS-42-32). June 1959. *Report on Effects of Corn Topping,* by J. L. Schmidt and W. G. Lovely (Bulletin ARS-49-35). August 1959. Agricultural Research Service, USDA, Beltsville, Md.

Agricultural Workers and Workmen's Compensation. Bulletin 206. June 1959. Bureau of Labor Standards, U.S. Department of Labor, Washington 25, D. C.

Planning Modern Farm Wiring. Booklet. Farm Electrification Bureau, National Electrical Manufacturers Assn., 155 E. 44th St., New York 17, N. Y. Price, 25 cents each. Quantity prices available.

Heat Lamps for Comfort of the Milking Parlor Operator, by A. F. Butchbaker and D. E. Wiant. Extension Folder 286, November 1959. Cooperative Extension Service, Michigan State University, East Lansing, Mich.

Swine Equipment Plans. Publication MWPS-2. 1959. Midwest Plan Service, Agricultural Engineering Bldg., Ames, Iowa. Price, $1.00.

How to Identify and Name Soils (Use of Scoreboard), by R. Earl Storie. Booklet. April 1959. Associated Students' Store, University of California, Berkeley, Calif. Price, $1.00.

Physical Treatment and Cracking of Sweet Cherries, by J. H. Levin, Carl W. Hall, and A. P. Deshmukh. Article 42-13. Reprinted from the "Quarterly Bulletin" of the Michigan Agricultural Experiment Station, Michigan State University, East Lansing. Vol. 42, No. 1, pages 133 to 141, August 1959.

Report of the Third Annual Conference of the Farm Buildings Association, held at Harrogate, England, March 18-20, 1959. Peter J. M. Aston, Hon. Secretary-Treasurer, Farm Buildings Association, Westfield, Braunston, Oakham, Rutland, England.

Remodeling the Model-T Farmhouse, by K. H. Hinchcliff. North Central Regional Publication 96 and Illinois Agricultural Experminet Station Bulletin 644. June 1959. Extension Service in Agriculture and Home Economics, University of Illinois, Urbana. Price, $1.00.

PERSONNEL SERVICE BULLETIN

Note: In this bulletin the following listings current and previously reported are not repeated in detail; for further information see the issue of AGRICULTURAL ENGINEERING indicated. "Agricultural Engineer" as used in these listings is not intended to imply any specific level of proficiency or registration as a professional engineer. Items published herein are summaries of mimeographed listings carried in the Personnel Service, copies of which will be furnished on request. To be listed in this bulletin, request form for Personnel Service listing.

Positions Open – **August**–O-215-936, 217-938, 212-940, 220-941, 223-942, 228-943, 228-944, 231-946, 231-947, 231-948, 247-949, 259-950, 259-951. **September** – O-219-954, 264-955, 275-956, 285-957, 277-958, 286-959. **October** – O-315-960, 323-961, 323-962 324-963. **November** – O-327-964, 328-965, 341-966, 320-967, 346-968, 353-969, 360-970, 352-971, 358-972, 361-973. **December** – O-378-974, 384-975, 386-976, 387-977, 370-980, 394-981, 404-982.

Positions Wanted – **August**–W-199-35, 210-36, 224-37. **September** – W-249-40, 258-41, 245-43, 267-44, 269-45. **October** – W-307-47, 321-49. **November** – W-330-50, 278-51, 284-52, 335-53, 336-54, 343-55, 329-56, 363-57. **December** – W-390-59, 388-60.

NEW POSITIONS OPEN

Customer Services Representative for planning, designing and promoting farm electric applications such as crop drying, feed processing, materials handling, and dairying, with public power district in upper Midwest. Practical farm background and/or agricultural education. Basic knowledge of electricity and advanced training or practical experience. Initiative, objective thinker, mechanical inclination, optimistic and personable. Additional training available on the job. Attractive salary plan and promotion potential. Excellent opportunity to express individual abilities in developing new department and programs. Salary $4524-5556 to start. O-395-983

Sales coordinator to prepare sales promotion material, develop sales promotions and conduct programs with dealers, for public power district in upper Midwest. Farm background and/or education, together with training and/or experience in journalism. Initiative, interest in promoting new ideas and concepts, and in getting results through others. Additional training available on the job. Unusual opportunity for self-expression, and for promoting application of modern management principles. Opportunity for advancement in the organization and industry. Salary $4524 to $5820. O-395-984

Agricultural Engineer (research associate) to develop and supervise research program in farm structures and related agricultural engineering problems, coordinate engineering projects related to agriculture and handle some teaching, in a Canadian university. MSAE preferred. BSAE considered. Mature, responsible, alert man who enjoys work with the public. Several years experience in general construction, heating, air conditioning and/or lighting, plus farm background and experience in dealing with agricultural problems. Normal opportunity for advancement. Salary open. O-441-985

Agricultural Engineer (research, professor) for work in power and machinery field on specific projects to be selected, with land grant college in the Southeast. Opportunity for some teaching. Age 25-45. BS and MS in agricultural or mechanical engineering. PhD desirable. Experience desirable but not essential. Research or development experience with industry preferred. Must have imagination, ability to work with others, and interest in professional progress. Appointee will lay groundwork for new program with excellent growth potential. Excellent opportunity for both research and teaching, including work with advanced students. Position now open. Salary open. Appointment may be made in associate professor grade with starting salary in $8,000-9,000 range. O-452-986

NEW POSITIONS WANTED

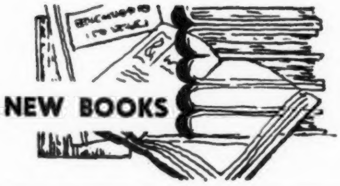
Agricultural Scientist for development or research in soil and water field with public service agency, anywhere in USA. Married. Age 27. No disability. Hungarian refugee. Speak and write English. Graduate (1956) University of Agriculture, Godollo, Hungary. Experience in agricultural laboratory, Hungary, 6 months. Soil test work, Dominican Republic, 2 years. Now technician, enzyme laboratory, Jacques Wolf Co. Available on reasonable notice. Salary open. W-411-61

Agricultural Engineer for development or research in power and machinery or soil and water field with manufacturer or public service in USA, Europe, or South America. Married. Age 26. No disability. BSAE expected in 1960, University of Maine. Military service 4 years Navy with aircraft pilot training and experience and promotion to Lt/JG. Summer work experience as mechanic, technical assistant, and agricultural engineering aid. Available June 20. Salary open. W-426-62

Agricultural Engineer for design, development or research in power and machinery or farm structures field, with industry or public service anywhere in USA, East preferred. Married. Age 22. No disability. BSAE expected June 1960, University of Maine. Farm background. Summer work experience on farm and with Agricultural Stabilization Board on soil bank program. Additional part-time work with agricultural engineering department. Available July 1. Salary open. W-427-63

Agricultural Promotion man for extension, sales, service or writing in power and machinery or rural electric field, with manufacturer, consultant or trade association in East or Northeast. Single. Age 27. No disability. BSA, University of Connecticut, 1955, with major in agricultural mechanics. Farm background, including management and operation of family farm, 7 years. Sales and service experience with farm equipment industry and electric utility. Available on reasonable notice. Salary open. W-433-64

Agricultural Engineer for teaching or research in power and machinery, with college, anywhere in U.S.A. Married. Age 26. No disability. BSME and MSAE, Michigan State University. Experience as graduate assistant. Commissioned service in U.S. Navy 3 years, Lt/JG. Available June 1960. Salary $7500. W-437-65



Symposium on Stability of Distillate Fuel Oils — STP 244. Paper. 6 x 9 in. Available at American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $2.75.

This symposium attempts to give broad coverage to the stability of distillate fuel oils, which is basically defined as the performance of the fuel; the quality of being able to endure without material change; and resistance to breakdown or decomposition. Included are the following subjects: Trials and tribulations of a large-development oil heating; predictive type tests for storage stability and compatibility of diesel fuels; requirements for dependable performance of domestic oil burner nozzles; need for a stability specification No. 2 heating oil; review of the distillate fuel stability problem; how distillate fuel stability is measured and controlled; incompatibility of distillate fuels; and distillate fuel oil gel.

Principles of Dairy Chemistry, by Robert Jenness and Stuart Patton. Cloth. 6 x 9¼ in. viii+446 pages. Illustrated and indexed. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. $8.75.

The main emphasis in this book is directed toward understanding the nature of milk — the chemistry of milk constituents — the interaction of constituents with one another under various conditions — and the relationship of all these facts to the production and storage of dairy products. Also included are descriptions of how to perform analyses and tests on milk, milk constituents and milk products. The authors explain the physical-chemical principles involved and the various merits and limitations of such procedures. One chapter deals with the nutrition of milk.

Soil Conservation, by Helmut Kohnke and Anson R. Bertrand. Cloth. 6¼ x 9½ in. vii+219 pages. Illustrated and indexed. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. $6.75.

The authors state that it is the purpose of this book to provide a clear picture of the fundamental nature and cause of soil erosion, of the aims of soil conservation, and of the methods of saving the soil and maintaining its productivity; that it is not the purpose of the book to give recipes for soil management, but to help the reader to understand the soil and what happens to it under various forms of land use, so that he, himself, can work out the solution of any soil-conservation problem. This book written primarily as a college text should be of interest to those concerned with land use problems, especially farm management specialists, county agents, and soil conservation personnel.

Using Electricity on the Farm, by J. Roland Hamilton. Cloth. 6 x 9¼ in. 397 pages. Illustrated and indexed. Published by Prentice-Hall, Inc., Englewood Cliffs, N. J. $6.65.

The text of this book consists of six problem-units dealing with the following phases of farm electricity: (1) Opportunities in using electricity to improve the farm; (2) common everyday principles of electricity for the farm; (3) farmstead wiring; (4) electric motors for the farm; (5) water pumps and lighting for the farm; and (6) electric farming equipment. It is a simplified reference and how-to-do-it guide for agriculture students, club workers, and farm people and is built largely around practical ideas for using electricity to improve the farm, with instructions on how to plan and do each major job. The illustrations and simplified examples in the book make it easy to read and understand.

Hydrology, Second Edition, by Chester O. Wisler and Ernest F. Brater. Cloth. 6 x 9¼ in. xiv + 408 pages. Illustrated and indexed. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. $9.25.

Two new chapters have been added to this second edition — one deals with the hydrology of semi-arid basis, and the other treats the effects of snow upon the hydrology of an area. Solutions to such field problems as: Determination of spillway and bridge discharge capacities; methods of flood reduction; water conservation practices; evaluation of potential water power on a river; and evaluation of amount of water available for water supply or waste disposal on a river are also covered in this book. Included in its new material, this text book gives the description of a dependable method for determining the magnitude of floods at specified rare frequencies.

RESEARCH NOTES

Brief news notes and reports on research activities of special agricultural-engineering interest are invited for publication under this heading. These may include announcements of new projects, concise progress reports giving new and timely data, etc. Address: Editor, AGRICULTURAL ENGINEERING, St. Joseph, Michigan.

New Use for Teflon

A Teflon plastic coating recently made possible the plowing of Davidson clay with a moldboard plow in experiments of USDA agricultural engineers at the National Tillage Machinery Laboratory, Auburn, Ala.

The plow bottom was completely covered with Teflon, and a ½-in. strip of beryllium copper was placed along the leading edge of the shear.

This finding by A. W. Cooper and I. F. Reed points to other uses for Teflon—wherever excessive soil adhesion is troublesome—such as on planter shoes, press wheels, and cultivating equipment.

Parker Joins Stoneville Staff

Rayburn E. Parker has joined the cotton mechanization staff of E. B. Williamson of USDA's Agricultural Research Service at Stoneville, Miss.

Mr. Parker received an M.S. degree in agricultural engineering last June from Texas A. & M. A native of Mississippi, he graduated in agricultural engineering from the State university there.

Farmstead Council Requests Design Assistance

The new Farmstead Council has requested more design information with plans prepared by the Cooperative Farm Building Plan Exchange. It also asked for more research on buildings and systems arrangements for various farm enterprises.

Council members Donald Richter, F. W. Kesler, and R. W. Fullbright indicated this recently. They met with Dr. E. G. McKibben, director, and other representatives of the Agricultural Engineering Research Division of USDA's Agricultural Research Service.

The council members said design information furnished with drawings would enable manufacturers of prefabricated buildings and industrial firms issuing plans to employ ARS research findings. The benefit would be a basis for design of buildings of equal functional value by different manufacturers. Industry also could more effectively contribute its ideas and experience to the plan exchange.

As a result of the discussions, AERD is developing a method for presenting the design information. This is expected to be a gradual process, to be expanded and improved as experience is gained.

Cotton Publications

Articles by three members of the Agricultural Engineering Research Division of USDA's Agricultural Research Service recently appeared in two cotton publications.

A research report in four parts by Walter E. Chapman, Jr., and Victor L. Stedronsky on cotton qualities as affected by ginning was printed in the Cotton Gin and Oil Mill Press during 1959. The reports give the effects of ginning treatments and seed cotton storage on ginning performance, combed yarn spinning properties, and fiber qualities of Acala 1517C hand-picked cotton.

Charles M. Merkel is author of an article on ginning cotton to preserve spinning quality while producing maximum bale value, printed in the Staple Cotton Review. Ginning recommendations, based on research findings, are included in the discussion.

USDA Engineers Aid in Important Find

Credit goes to USDA agricultural engineers K. H. Norris and G. S. Birth for developing instrumentation that enables direct spectrophotometric measurement of the photoreversible pigment that controls plant development from germination to flowering.

The pigment was isolated recently at Beltsville, Md., by Dr. S. B. Hendricks, Dr. H. A. Borthwick, Dr. H. W. Siegelman, of USDA's Agricultural Research Service, Dr. W. L. Butler, and Mr. Norris of the Department's Agricultural Marketing Service.

Plant scientists throughout the world have been seeking this pigment for more than a decade. The pigment is present in plants in such low concentrations that previous efforts to isolate it have failed.

The research team isolated the pigment in a number of different plant tissues, and also extracted and concentrated it in preparation for purification and identification.

An explanation of the pigment's action was made before Russian Premier Khrushchev during his recent visit to USDA's Research Center at Beltsville. Mr. Norris aided Dr. Borthwick, who discussed the finding, by operating the dual-monochromator spectro-photometer used to show presence and form of the pigment.

A prototype of the instrument, developed by Mr. Norris for spectrophotometry of intact agricultural commodities, was described in AGRICULTURAL ENGINEERING, October 1958. The newest adaptation of the instrument was discussed at the 1959 Winter Meeting of ASAE

The technical program for the Russians at Beltsville included a demonstration of the "Echoscope" by the Agricultural Engineering and Animal Husbandry Research Divisions of ARS. L. E. Campbell and E. K. Johnson of the Farm Electrification Research Branch of AERD operated the ultrasonic device that measures backfat thickness in hogs.

Cotton Report Available

A progress report on the effects of exposing cotton to gas plasmas is available from USDA. R. B. Stone, Jr., engineer of the Farm Electrification Research Branch of AERD, ARS, at Knoxville, Tenn., prepared the information with cooperation of the Tennessee Agricultural Experiment Station.

Mr. Stone is using irradiation from a laboratory device invented by Dr. O. A. Brown, former USDA engineer and now consultant, to change the physical characteristics of cotton seed and fiber. A 3-year test is underway in three States to determine the effects of the treatment on emergence, survival, growth, and yield of cotton.

Copies of the report will be sent by the Information Division, Agricultural Research Service, U.S. Department of Agriculture, Washington 25, D.C. Ask for ARS 42-37, September 1959.

Bond on Berkeley Campus

USDA agricultural engineer T. E. Bond is temporarily located on the Berkeley campus of the University of California, where he is taking advanced training in agricultural engineering.

Mr. Bond's permanent station is at Davis, Calif., where he conducts investigations as a member of the Livestock Engineering and Farm Structures Research Branch, AERD, ARS.

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Atallah, Nicolas J. — Instructor in irrigation, dept. of agr. eng., School of Agriculture, American University of Beirut, Beirut, Lebanon

Barry, LeRoy F. — Managing dir., Mid-West Retail Farm Equipment Assn., 4929 N. 30th St., Omaha 11, Nebr.

Bergeron, James A. — Engr., Miller & Poston Mfg. Co., N-1115 Havana, Spokane, Wash.

Cleary, Thomas J.—Adviser, Industrial Enterprises, Ltd., Box 109, P.O., Toowomba, Qld., Australia

Coffelt, Robert J. — Asst. spec., agr. eng. dept., University of California, Davis, Calif.

Cook, George E. — Asst. professor of agr. eng., agr. eng. dept., Oklahoma State University, Stillwater, Okla.

Deal, Marvin W. — Agr. sales engr., Goodyear Tire and Rubber Co., 56th and Morrill Ave., Lincoln, Nebr.

Doman, Fred — Engr., J. I. Case Co. (Mail) 2201 E. Lombard, Davenport, Iowa

Eagar, Thomas N. — Asst. in agr. eng., agr. eng. dept., Auburn University, Auburn, Ala.

Egloff, William F. — Vice-president, Asphalt Corp. of America, P.O. Box 826, Danville, Ill.

Flocker, William J. — Lecturer and asst. olericulturist, vegetable crops dept., University of California, Davis, Calif.

Franklin, Dawson C., Jr. — Business management spec. for central region, Massey-Ferguson, Ltd. (Mail) 4740 Roanoke Parkway, Kansas City 12, Mo.

Franks, Gerald N. — Agr. engr., U.S. Cotton Ginning Laboratory (ARS), USDA, Box 426, Leland, Miss.

Fullbright, Russell W. — Design engr., Clay Equipment Corp. (Mail) 1603 Franklin, Cedar Falls, Iowa

Hadjigeorgiou, Panos — Agr. office, Director of Mechanical Cultivation Service. (Mail) Agias, Sophias 40, Salonika, Greece

Hahn, Herbert S. — Proj. engr., John Bean Div., Food Machinery and Chemical Corp. (Mail) 825 N. Francis St., Lansing, Mich.

Haight, Robert E. — Engr., John Deere Tractor Works. (Mail) 1420 Liberty St., Waterloo, Iowa

Hall, Harold A. — Drainage engr., (SCS) USDA. (Mail) 19501 W. Greenfield Ave., New Berlin, Wis.

Harned, Stanley K. — Sales and supervision, Homasote Co. (Mail) 1814 Cypress Ave., Champaign, Ill.

Hartford, Robert F. — Executive dir., Pennsylvania Retail Farm and Industrial Equip. Assn. (Mail) Box 292, Phoenixville, Pa.

Helvey, Lozier M. — Planning consultant, Tri-State Glass Lined Storage. (Mail) 118 S. Scott St., Warsaw, Ind.

Holland, John J., Jr. — Graduate student, civil and irrigation eng. dept., Utah State University, Logan, Utah

Johansson, Johan E. — Serv. mgr., Arvika-Thermaenius AB. (Mail) Storgatan 47, Katrineholm, Sweden

Lill, E. G. — Proj. engr., John Bean Div., Food Machinery and Chemical Corp., Lansing, Mich.

Lomas, William F. — Supervisor, res. eng., Ford Tractor and Implement Div. (Mail) 17269 Sunnybrook, Southfield, Mich.

McDermott, William C. — Product des. draftsman, Allis-Chalmers Mfg. Co. (Mail) R.R. 2, Box 329-C, LaPorte, Ind.

McRobert, Leon R. — Proj. engr., John Bean Div. of Food Machinery and Chemical Corp., 1305 S. Cedar St., Lansing, Mich.

Marley, Stephen J. — Graduate asst., agr. eng. dept., Iowa State Univ. (Mail) 449A Pammel Ct., Ames, Iowa

Matthies, Hans J. — Prof., Dr. Eng., Institut fur Landmaschinen der Technischen Hochschule Braunschweig, Langer Kamp 19, Germany

Meister, Earl E. — Farm serv. rep., farm sales dept., Connecticut Light and Power Co. (Mail) R.R. 1, Bethlehem, Conn.

Mohanty, Prasanta K. — Asst. prof., civil and irrigation eng. dept., Utah State Univ., Logan, Utah

Nettles, Albert A. — Vice-president and mgr., Peterman Agr. Co. (Mail) 409 York St., Monroeville, Ala.

Parker, David — Serv. engr., agr. res. service, building products dept., Kaiser Aluminum and Chemical Sales, Inc. (Mail) 237 W. Butterfield Rd., Elmhurst, Ill.

Patterson, Joseph M. — Sr. proj. engr., John Bean Div., Food Machinery and Chemical Corp., P.O. Box 840, Lansing, Michigan

Perez, Pedro F. — Tire designer, Goodyear Tire and Rubber Co. (Mail) 432 Fernwood Ave., Tallmadge, Ohio

Peterson, Lyle H.—Student engr., John Deere Waterloo Tractor Works. (Mail) 246 Western Ave., Waterloo, Iowa

Priorelli, Giuseppe F. — Prof. and dir. of agr. eng. dept., Instituto Di Meccanica Agraria, Via Michelangelo, 32, Torino, Italy

Redenbaugh, Robert E. — Sales mgr. of OEM sales, Lincoln Engineering Co, 4010 Goodfellow Blvd., St. Louis 20, Mo.

Semrau, Frank — Product mgr., A. O. Smith International SA, P.O. Box 331, Milwaukee 1, Wis.

Slobodyanik, Nicholas F. — Agr. engr., Univ. of Massachusetts. (Mail) R.R. 3, Mills, Amherst, Mass.

Swinford, George E. — Power use advisor, White County R.E.M.C. (Mail) R.R. 5, Monticello, Ind.

Towson, Arthur L., Jr. — Dir. of agr. eng., Chisholm-Ryder Co., Drawer F, Bridge Station, Niagara Falls, N.Y.

Ver Ploeg, Wendell J. — Res. engr., Tractor and Implement Div., Ford Motor Co. (Mail) 1818 Rowland, Royal Oak, Mich.

Wann, Richard L. — Mgr., tractor tire eng., Firestone Tire and Rubber Co. (Mail) 2426 21st St., Cuyahoga Falls, Ohio

Westcott, Horace D. — Product planning field spec., Massey-Ferguson, Ltd. (Mail) 728 Elmwood Dr., Davis, Calif.

Willis, Billy B. — Asst. engr., Allis-Chalmers Mfg. Co. (Mail) 110 Graceland Dr., 'LaPorte, Ind.

Winter, B. B. — Towanda, Ill.

TRANSFER OF MEMBERSHIP

Bogner, Neil F. — Area engr. and government rep., (SCS) USDA. (Mail) 510 E. Washington, Macomb, Ill. (Associate Member to Member)

Carnahan, Herbert E. — Agr. engr., (SCS) USDA. (Mail) 240 Maureen Lane, Moorpark, Calif. (Affiliate to Associate Member)

Cloud, Harold A. — Asst. managing dir., American Concrete Pressure Pipe Assn., 228 N. LaSalle St., Chicago, Ill. (Associate Member to Member)

Harrison, Dalton S. — Ext. agr. engr., agr. ext. service, University of Florida, Gainesville, Fla. (Associate Member to Member)

Hedges, Winston H. — Reg. canal and drainage engr., design and construction div., Bur. of Reclamation, USDI. (Mail) 3920 W. Floyd Ave., Denver 19, Colo. (Associate Member to Member)

Hunck, Billie G. — Engr., dev. section, John Deere Res. and Eng. Center. (Mail) 505 Utah Rd., Cedar Falls, Iowa (Associate Member to Member)

Johnson, Maurice, Jr. — Chief engr., eng. div., res. dept., Sunkist Growers, Inc. (Mail) 616 E. Sunkist St., Ontario, Calif. (Associate Member to Member)

Neal, Maurice E. B. — Agr. engr., agr. eng. branch, FAO, P.B. 863, Tunis, Tunisia (Affiliate to Member)

Nelson, Dwight F. — Product des. engr., John Deere Industrial Equip. Works. (Mail) 1212 13th Ave., Moline, Ill. (Associate Member to Member)

Rousseau-Portalis, Jean — Dir., head of new dev. dept., Fiat Someca Concord. (Mail) Las Heras 3702, Buenos Aires, Argentina (Associate Member to Member)

Schwalm, Bruce D. — Des. engr., New Holland Machine Div., Sperry Rand Corp. (Mail) 27 Rose Ave., Leola, Pa. (Associate Member to Member)

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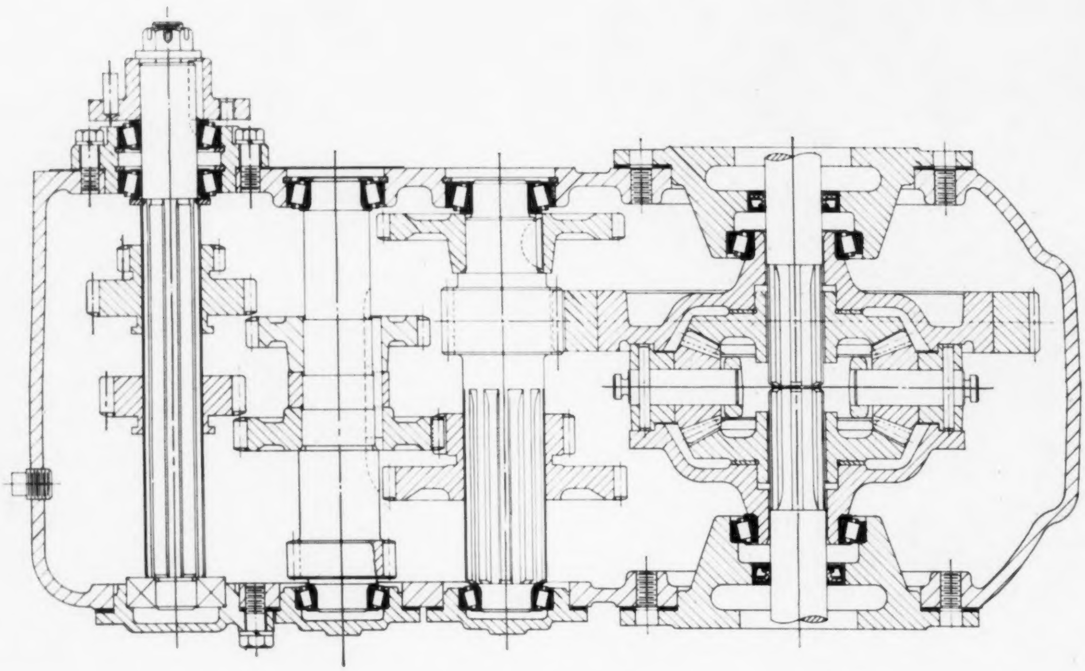
John Deere gets maximum design economy in new cotton picker transmission

Uses Timken® bearings on all shafts for greater rigidity, longer life



BY using Timken® tapered roller bearings on all four shafts in the transmission of their new 99 cotton picker, John Deere engineers get maximum design economy. And they achieve greater rigidity, longer life at lowest cost. Timken bearings provide rigid support for shafts, keep gears positively aligned. In fact, no other bearing can give equal capacity at the price. Here's why:

Timken bearings are *tapered* to take all combinations of loads, both radial and thrust. And full line contact between rollers and races gives Timken bearings *extra* load-carrying capacity. Most important—Timken bearings are geometrically designed to roll true and *precision* manufactured to live up to their design.

And what's more, by holding shafts concentric with their housings, Timken bearings make seals more effective in keeping dirt out, lubricant in. Only the finest bearing steel available is used in Timken Bearings.

Timken bearings solve three of your big problems: 1) combination loads; 2) dirt; 3) ease of operation. And from the wide variety of Timken bearing sizes and capacities, you can get the one bearing best suited for each position —the one that will most effectively meet all requirements.

More economical and compact designs are big reasons why more engineers are standardizing on Timken bearings. Timken Company engineers will gladly work with you on your designs. They've developed new methods for calculating bearing loads to meet the needs of various types of farm machines working under many different operating conditions. Write: The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable "TIMROSCO". Makers of Tapered Roller Bearings, Fine Alloy Steels and Removable Rock Bits.

NOT JUST A BALL · NOT JUST A ROLLER · THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

The farmer's as[illegible]nce of better design

Tapered Roller TIMKEN BEARING EQUIPPED